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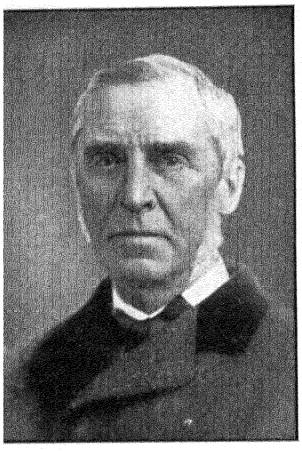
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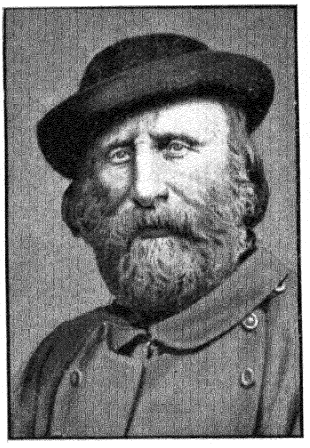
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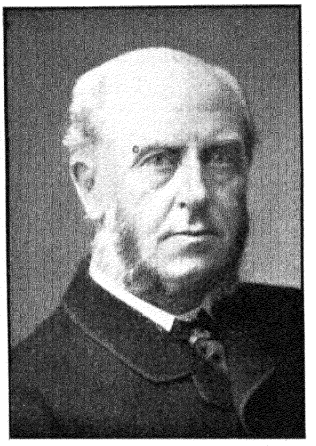
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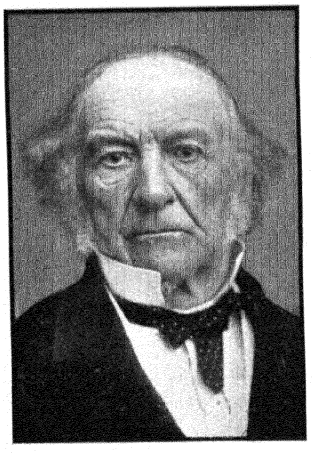
J. A. Froude



Garibaldi



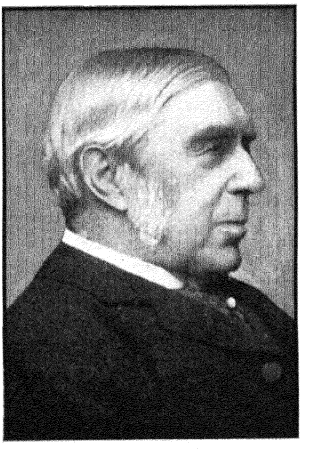
Sir A. Geikie



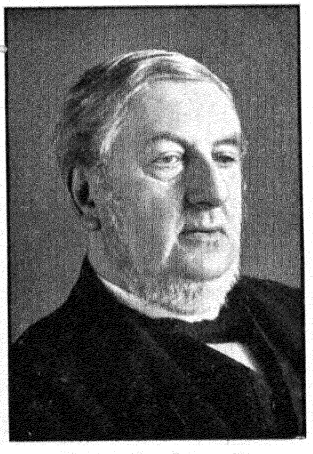
W. E. Gladstone



General Gordon



Lord Goschen



Sir W. V. Harcourt



Thomas Hardy



H. Rider Haggard

* The portraits are from photographs by Messrs. Elliott & Fry, with the exception of Garibaldi (Maull & Co.), W. E. Gladstone (Samuel A. Walker), and General Gordon (London Stereoscopic Co.).

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IN

THE VARIOUS BRANCHES OF HUMAN KNOWLEDGE

Volume VI

THE GRESHAM PUBLISHING COMPANY
LONDON AND GLASGOW

LIST OF PLATES AND MAPS.

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KEY: ā as in fate or in fare, ä as in far (sometimes short, sometimes long), a as in fat, ą as in fall; ē as in me, e as in met, é as in her; ī as in pine, i as in pin; ō as in note, o as in not, ŏ as in move; ū as in tube, u as in tub, ų as in bull, ü, the French u (sometimes short, sometimes long); ou as in pound; ch as in chain; ȟ as in Scotch loch, German nach; ñ as in French ton; th as in thin; *th* as in this; w and y always consonants; zh as z in azure or j in French jaune.

Franche-Comté, frăñsh-koñ-tā
Franchise, fran'chīz
Francke, fran'kē
François, frăñ-swä
Francolin, fran'ko-lin
Franc-tireur, fraṅ-tē-rér
Franeker, frä'ne-ker
Frankalmoigne, frank'al-moin
Frankenberg, fräṅ'ken-berȟ
Frankenhausen, fräṅ'ken-hou-zn
Frankenstein, fräṅ'ken-stīn
Frankenthal, fran'ken-täl
Franzensbad, fran'tsens-bät
Frascati, fräs-ka'tē
Frasera, frā'se-ra
Fraticelli, fra-tē-chel'lē
Frattamaggiore, frät-tä-mā-jō'rā
Frauenlob, frou'en-lōp
Fraunhofer, froun'hō-fėr
Fraustadt, frou'stät
Fraxinus, frak'si-nus
Fray Bentos, frī ben'tōs
Frechette, fré-shet'
Frederikshald, fred'er-iks-häl
Freiberg, frī'berȟ
Freiburg, frī'bųrȟ
Freienwalde, frī'en-väl-dē
Freiligrath, frī'liȟ-rät
Freising, frīz'ing
Fréjus, frā-zhüs
Frere, frēr
Fréron, frā-rōṅ
Fresnel, frā-nel
Fresnillo, fres-nil'yō
Freudenstadt, froi'den-stät
Freycinet, frā-sē-nā
Freytag, frī'tāȟ
Fribourg, frē-bor
Fricassee, fri-kas-sē'
Friedland, frēd'länt
Friedrich, frēd'riȟ
Friedrichsthal, frēd'riȟs-täl
Frieze, frēz
Frisches Haff, frish'es haf
Frithjof, frōt'yof
Fritillary, frit'il-a-ri
Friuli, fri-ō'lē
Frobisher, frō'bish-ėr
Froebel, fré'bel
Froissart, frwä-sär
Fronde, frōnd
Frontinus, fron-tī'nus
Froschdorf, frosh'dorf
Frosinone, frō-si-nō'nā
Froude, frōd
Fuchsia, fū'shi-a
Fucino, fō'chē-nō
Fuente, fų-en'tā
Fuero, fų-ā'rō
Fugue, fūg
Fulham, fųl'am
Fulica, fū'li-ka
Fuller, fųl'ėr
Funchal, fųn-shäl'
Fünfkirchen, fünf'kirȟ-en
Fungi, fun'jī
Furlough, fėr'lō
Furneaux, fėr'nō
Furnes, fürn
Furness, fėr'nes
Fürst, fürst
Fürstenwalde, fürst'en-väl-dē
Fürth, fürt
Fusaro, fō-sä'rō
Fuseli, fū'se-li
Futhork, fų'thork
Fyne, fīn
Fyrd, fėrd
Fyt, fīt
Fyzabad, fī-zä-bäd'

G

Gaballs, gä-bä-lē
Gabelle, gä-bel'
Gaboon, ga-bön'
Gaboriau, gä-bō-ri-ō
Gadara, gad'a-rä
Gade, gä'de
Gadebusch, gä'dē-bōsh
Gaedhelic, gā'el-ik
Gaekwar, gīk-wär'
Gaëta, gā-ā'ta
Gahn, gan
Gaillac, gä-yäk
Gaius, gā'yus
Galago, ga-lā'go
Galapagos, ga-lap'a-gōs
Galashiels, gal-a-shēlz'
Galatea, gal-a-tē'a
Galatz, Galacz, ga-lats'
Galbanum, gal'ba-num
Gale, gā'lē
Galeidæ, ga-lē'i-dē
Galemys, ga-lē'mis
Galena, ga-lē'na
Galesburg, gālz'burg
Galilei, gäl-i-lā'ē
Galingale, gal'in-gāl
Gallait, gal-lā
Galland, gal-äñ
Galle, gal
Gallienus, gal-i-ē'nus
Gallinule, gal'i-nūl
Gallipoli, gal-lip'o-lē
Galloon, gal-lön'
Galveston, gal'ves-tun
Galway, gal'wā
Gamaliel, ga-mā'li-el
Gandak, gan-dak' or gun-duk'
Gandamak, gan-da-mak'
Ganesa, ga-nā'sa
Ganges (river), gan'jez
Ganges (town), gäñzh
Gangi, gän'jē
Gangpur, gang-pör'
Gangrene, gang'grēn
Gangue, gang
Gannat, gän-ä
Ganymede, gan'i-mēd
Gap, gäp
Garancine, gar'an-sēn
Garay, gä'rī
Garcilaso de la Vega, gär-thē-lä'sō
Gard, gär
Gardaiȝ, gär-dü'yä
Garde Écossaise, gärd ā-kos-āz
Gardelegen, gär'dē-lā-gen
Garde Nationale, gärd nä-syo-näl
Garde Nationale Mobile, gärd nä-syo-näl mō-bēl
Garganey, gär'ga-nā
Gargano, gär-gä'nō
Gargantua, gär-gan'tū-a
Gargara, gär'ga-ra
Garhwal, gur-hwäl'
Gariep, ga-rēp'
Garigliano, gä-rēl-yä'nō
Garofalo, gä-rof'a-lō
Garonne, gä-ron'
Garrote, gär-rō'tä
Gascoigne, gas-koin'
Gascony, gas'ko-ni
Gassendi, gäs-sen'dē
Gastein, gäs'tīn
Gaston de Foix, gäs-tōñ dė fwä
Gâtinais, gä-tē-nā
Gatineau, gat-i-nō'
Gatschina, gat'shi-nä
Gau, gou
Gauchos, ga'ų-chōs
Gauge, gāj
Gault, gąlt
Gaur, gour
Gauss, gous
Gautama, gą'ta-ma
Gautier, gō-ti-ā
Gavazzi, gä-vät'sē
Gavotte, ga-vot'
Gayá, ga-ya'
Gay-Lussac, gā-lüs-äk
Gazelle, ga-zel'
Gazette, ga-zet'
Gazetteer, ga-zet-ēr'
Gean, gēn
Geber, gē'bėr
Gebweiler, geb-vī'lėr
Ged, ged
Geddes, ged'es
Geefs, gāfs
Geel, gāl
Geelong, jē-long'
Geestemunde, gās'tē-mün-dē
Geez, gēz
Gefle, yef'le
Gehlen, gā'lėn
Gehler, gā'lėr
Geibel, gī'bl
Geijer, gī'yėr
Geikie, gē'ki
Geissler, gīs'lėr
Gela, jā'lä
Gelada, gel'a-da
Gelasius, je-lā'si-us
Geldern, gel'dėrn
Gelée, zhē-lā
Gell, jel'
Gellert, gel'ėrt
Gellius, jel'i-us
Gellivara, gel-li-vä'rä
Gelnhausen, geln'hou-zn
Gelon, jē'lon
Gelsenkirchen, gel'zn-kirȟ-en
Gemara, ge-mä'rä
Gembloux, zäñ-blō
Gemini, jem'i-nī
Gemsbok, gemz'bok
Gendarmes, zhäñ'därm
Genesee, jen-e-sē'
Genet, jen'et
Geneva, je-nē'va
Genevière, jen'e-vēv or zhen-vi-āv
Gengis (Khan), jen'gis
Genlis, zäñ-lēs
Genoa, jen'o-a
Genre, zhäñ-r
Genseric, jen'se-rik
Gentoo, jen-tō'
Gentz, gents
Geodes, jē'ōdz
Geodesy, jē-o'de-si
Geoffrey, jef'ri
Geoffrin, zhof-räñ
Geoffroy, zhof-rwä
Geoffroy St. Hilaire, zhof-rwä saṅ tē-lâr
Geophagism, jē-of'a-jizm
Geotropism, jē-ot'ro-pizm
Gera, gā'rä
Gerace, je-rä'chä
Gérard, zhā'rär
Gerasa, je-rā'sä
Gerhard, ger'härt
Gerhardt, ger'härt
Géricault, zhā-rē-kō
Gerizim, ge-rī'zim
Germain, zher-maṅ
Germander, jer-man'dėr
Germanicus, jer-man'i-kus
Germersheim, ger'mėrz-hīm
Gérôme, zhār-ōm
Gerona, ȟā-rō'nä
Gers, zhār
Gerson, zhār-sōñ
Gerstäcker, ger'stek-ėr
Gervinus, ger-vē'nųs
Gesenius, ge-sen'i-ųs
Gesner, ges'nėr
Gessner, ges'nėr
Getæ, jē'tē
Gethsemane, geth-sem'a-nē
Gettysburg, get'iz-burg
Geum, jē'um
Geysers, gī'zėrz
Ghadames, gä-dä'mes
Ghats, gäts
Ghazipur, gä-zi-pör'
Ghebers, gē'bėrz
Ghee, gē
Gheel, gāl
Ghent, gent
Gherardesca, gā-rär-des'kä
Ghetto, get'tō
Ghibellines, gib'el-linz
Ghiberti, gē-ber'tē
Ghilan, gi-län'
Ghirlandalo, gir-län-dä'yō
Giallo Antico, jäl'ō än-tē'kō
Gianibelli, jän-i-bel'lē
Giannone, jän-ō'nā
Giaour, jour
Giarre, ji-ar'rā
Gibel, jib'el
Gibraltar, jib-ral'tar
Giczin, yit'shin
Giers, gėrz
Giesecke, gē'ze-kē
Giessen, gē'sėn
Gifford, gif'ord
Gijon, ȟē-ȟōn'
Gila, jē'la
Gilbert, gil'bėrt
Gildas, gil'das
Giles, jilz
Gilfillan, gil-fil'an
Gilghit, gil'git
Gilles, zhēl
Gillies, gil'iz
Gillray, gil-rā'
Gillyflower, jil'i-flour
Gilolo, ji-lō'lō
Gimbals, jim'balz
Gimp, gimp
Gingal, jin'gal
Gingelly, jin-jel'i

Gingham, ging'am
Gingko, ging'kō
Ginguené, gañ-gē-nā
Ginsburg, gins'burh
Ginseng, jin'seng
Giobertí, jō-ber'tē
Gioja del Colle, jō'yä del kol'lä
Giojosa, jō-yō'zä
Giordano, jor-dä'nō
Giorgione, jor-jō'nā
Giotto, jot'tō
Giovanni, jō-vän'nē
Giovinazzo, jō-vē-nät'sō
Giraffe, ji-raf'
Girardin, zhē-rär-dañ
Girasol, ji'ra-sōl
Girgeh, jir'jä
Girgenti, jir-jen'tē
Girodet-Trioson, zhē-ro-dā-trē-o-sōñ
Gironde, zhē-rōnd
Girvan, gir'van
Gisors, zhē-sōr
Gitschin, yit'shin
Giuliano, jō-lē-ä'nō
Giulini, jō-lē'nē
Giulio Romano, jō'lē-ō rō-mä'nō
Giurgievo, jur-jä'vō
Giusti, jus'tē
Givet, zhē-vā
Givors, zhē-vōr
Gizeh, gē'zä
Gladbach, Bergisch-, berg'ish-gläd-bäh
Gladbach, Mönchen-, mén'-hen-gläd-bäh
Gladiolus, gla-di'o-lus
Glarus, glä'rös
Glauber, glou'bėr
Glauchau, glou'hou
Glaucoma, gla-kō'ma
Gleiwitz, glī'vits
Glencoe, glen-kō'
Glenlivet, glen-liv'et
Globigerina, glō-bi-je-rī'na
Glogau, glō'gou
Gloucester, glos'tėr
Gluchov, glo'hov
Gluck, gluk
Glückstadt, glük'stät
Glycerine, glis'ėr-in
Gmelin, gmel'in
Gmünd, gmunt
Gmunden, gmun'dėn
Gneisenau, gnī'zn-ou
Gneiss, nis
Gneist, gnīst
Gnesen, gnā'zn
Gnome, nōm
Gnomon, nō'mon
Gnomonics, nō-mon'iks
Gnostics, nos'tiks
Gnu, nū
Gobelins, gob-lañ
Godavari, go-dä'va-rē
Godiva, go-dī'va
Goes, hös
Goethe, gē'tė
Goltre, goi'tėr
Goldau, gold'ou
Goldoni, gol-dō'nē
Goldschmidt, golt'shmit
Gombroon, gom-brön'
Gomera, gō-mā'rä
Gomuti, go-mō'tē
Gonaives, go-nä'i-ves
Gondokoro, gon-do-kō'rō
Gondola, gon'do-la
Gonfalon, gon'fa-lon
Gongora, gon-gō'rä
Gonorrhœa, gon-o-rē'a
Gonville and Caius, gon'vil and kēz
Goole, gōl
Göppingen, gėp'ing-en
Goree, go-rē'
Gorgias, gor'ji-as
Gorgonzola, gor-gon-zō'lä
Görlitz, gėr'lits
Görres, gėr'res
Górz, gėrts
Goschen, gō'shen
Gosse, gos
Göteborg, yė'te-borg
Gotha, gō'tä
Gothard, goth'ard, got'härd
Göttingen, gėt'ing-en
Gottsched, got'shet
Gouda, gou'da
Goudimel, gö-di-mel
Gough, gof
Goulburn, göl'bėrn
Gould, gōld
Gounod, gö-nō
Goura, gou'ra
Gourd, gōrd
Gourock, go'rok
Govan, gov'an
Gower, gou'ėr or gōr
Gozzoli, got'sō-lē
Graaff-Reinet, gräf-rī'net
Graffiti, graf-fē'tē
Gragnano, grä-nyä'nō
Graham, grām or grā'am
Grahame, grām or grā'am
Grakle, grā'kl
Grallatores, gral-a-tō'rēz
Granada, grä-nä'dä
Grand Prix, gräñ prē
Grangemouth, gränj'mouth
Granja, gräṅ'hä
Grantham, grant'am
Granville (French), gräñ-vēl
Grasse, gräs
Gratiola, gra-tī'o-la
Gratz, Graz, grats
Graudenz, grou'dents
Gravelines, gräv-lēn
Gravelotte, gräv-lot
Gravesend, grāvz-end'
Gravina, grä-vē'na
Gray, grā
Graywacke, grā-wak'e
Grebe, grēb
Greeley, grē'li
Greenwich, grēn'ich
Gregarina, gre-ga-rī'na
Grégoire, grä-gwär
Gregory, gre'go-ri
Greifenberg, grī'fn-berh
Greifenhagen, grī'fn-hä-gėn
Greifswald, grīfs'vält
Greiz, grits
Gresham, gresh'am
Gresset, grä-sä
Grétry, grä-trē
Greuze, grėz (long)
Greville, grev'il
Griesbach, grēs'bäh
Grillparzer, gril'pär-tsėr
Grimsby, grimz'bi
Grindelwald, grin'dl-vält
Griqualand, grē'kwa-land
Grisi, grē'sē
Gris-Nez, grē-nā
Grisons, grē-sōñ
Grivegnée, grēv-nyā
Groningen, grō'ning-en
Groote Eylandt, grō'te ī'länt
Gros, grō
Groschen, grō'shen
Gross-Beeren, grōs'bā-rėn
Grossenhain, grōs'en-hīn
Grosswardein, grōs'vär-dīn
Grosvenor, grō've-nor
Grouchy, grö-shē
Grünberg, grün'berh
Grütli, grüt'lē
Gruyère, grü-yār
Grysbok, grīs'bok
Guacharo, gwä-chä'rō
Guadalajara, gwä-dä-lä-hä'rä
Guadalaxara, gwä-dä-lä-hä'rä
Guadalquivir, gwä-dal-kē-vēr'
Guadeloupe, gä-dė-löp
Guadiana, gwä-di-ä'nä
Guadix, gwä-dēh'
Gualacum, gwī'a-kum
Gualeguay, gwä'le-gwī
Gualegwaychú, gwä-le-gwī-chō'
Guanaco, gwän-ä'kō
Guanahani, gwä-nä-hä'nē
Guanaxuato, gwä-nä-hwä'tō
Guanches, gų-an'chez
Guapore, gwä-pō'rä
Guarana, gwä-rä'nä
Guardafui, gwär-dä-fwē'
Guarini, gwä-rē'nē
Guastalla, gwäs-täl'lä
Guatemala, gwä-te-ma'lä
Guava, gwa'va
Guaviare, gwä-vi-ä'rä
Guayaquil, gwī-a-kēl'
Guayra, gwī'ra
Gubbio, gųb'i-ō
Guben, go'ben
Guebers, gē'bėrz
Guelphs, gwelfs
Guelwiller, geb'vil-ėr
Guelder (Rose), gel'dėr
Guercino da Cento, gwer-chē'nō da chen'tō
Guereza, Guerza, ger'e-za, ger'za
Guericke, ger'ik-e
Guérin, gä-raṅ
Guernsey, gėrn'zi
Guerrero, ger-rā'rō
Guerrillas, ge-ril'az; Span., ge-rīl'yas
Gueux, gė (long)
Guevara y Dueñas, gā-vä'rä ē dų-en'yäs
Guglielmi, gųl-yel'mē
Guiana, gī-an'a
Guicciardini, gwē-chär-dē'nē
Guicowar, gī-ko-wär'
Guido Aretino, gwē'dō ä-re-tē'nō
Guidon, gī'don
Guido Reni, gwē'dō rā'nē
Guienne, gē-en'
Guignes, gēny
Guignet, gēn-yā
Guillemot, gil'e-mot
Guilloche, gil-losh'
Guillotine, gil-lo-tēn'
Guimarães, gē-mä-rāns'
Guinea, gin'ē
Guingamp, gañ-gāñ
Guipuzcoa, gē-pųth'ko-ä
Guisborough, giz'bu-rō
Guiscard, gis-kär
Guise, gwēz
Guitar, gi-tär'
Guizot, gē-zō
Gujerat, gųj-e-rät'
Gules, gölz
Gunnera, gun'ne-ra
Güns, günz
Gurmukteswar, gur-muk-tes'wär
Gustavus, gus-tā'vus
Güstrow, güs'trō
Gutenberg, gö'tn-berh
Guthrie, guth'ri
Gutta-percha, gut'a pėr'cha
Gutzkow, gųts'kō
Gützlaff, güts'läf
Guy, gī
Guy de Chauliac, gē dė shō-li-äk
Guyon, gē-yōñ
Guyot, gē-yō
Gyges, jī'jēz
Gymnasium, jim-nā'zi-um
Gymnogen, jim'no-gen
Gymnosperm, jim'no-spėrm
Gymnotus, jim-nō'tus
Gympie, gim'pi
Gynæceum, jin-ē'sē-um
Gynandria, jin-an'dri-a
Gynerium, jin-ē'ri-um
Gyöngyos, dyėn'dyėsh
Gypaëtus, ji-pā'ē-tus
Gypsum, jip'sum
Gyrencephala, ji-ren-sef'a-la
Gyroscope, jī'ro-skōp
Gyula, dyö'lä

H

Haarlem, här'lem
Habakkuk, ha-bak'kuk
Habergeon, ha-bėr'jon
Hackländer, hak'len-dėr
Hadersleben, hä'dėrz-lā-bėn
Hades, hā'dēz
Hæckel, hek'l
Hæmatemesis, hē-ma-tem'e-sis
Hæmatin, hē'ma-tin
Hæmatopus, hē-mat'o-pus
Hæmatozoa, hē-ma-to-zō'a
Hagedorn, ha'gė-dorn
Hagen, ha'gėn
Hagenau, ha'gė-nou
Haggai, hag'ā-i
Hagiographa, hā-ji-og'ra-fa
Hagiology, hā-ji-ol'o-ji
Hague, hāg
Hahnemann, hä'nė-män
Haiducks, hī'dųks
Haifa, hī'fä
Hainan, hī-nan'
Hainaut, ā-nō
Hainburg, hīn'burh
Hainichen, hīn'ī-hen
Hakluyt, hak'lōt
Hakodate, ha-kō-dä'te
Halacha, hal'a-ka
Halberstadt, häl'bėr-stät
Halévy, a-lā-vē
Haliaetus, hal-i-ā'ē-tus
Halichondria, hal-i-kon'dri-a
Halicore, ha-lik'o-rē
Haliotis, ha-li-ō'tis
Halle, häl'lē
Halluin, äl-ü-añ
Halmstadt, hälm'stät
Ham (town), äm
Hamadan, ha-mä-dän'
Hamah, hä'ma
Hameln, hä'meln
Hamerton, hä'mėr-tun
Hamilcar, ha-mil'kar
Hamilton, ham'il-tųn
Hanau, hän'ou
Hankow, han-kou'
Hanoi, hä-noi'
Hanumán, han-ų-män'
Hapsburg, häps'burh
Harcourt, här'kurt
Harderwijk, här'dėr-vīk
Hardinge, här'ding
Hardouin, är-dö-añ

FRANCE, Isle of. See Mauritius.

FRANCE, Isle of (*Île-de-France*), an ancient province of France, originally bounded by the Seine, Marne, Ourcq, Aisne, and Oise, and forming almost an island; capital Paris. Its area, as latterly extended, embraces the departments of Seine-et-Oise, Seine-et-Marne, Oise, Aisne, and parts of others.

FRANCESCO DI PAULA. See Francis of Paula.

FRANCHE-COMTÉ, an ancient province of France, forming at present the departments of Doubs, Haute Saône, and Jura. It formed part of the Kingdom of Burgundy founded at the beginning of the fourth century. On the death of Charles the Bold in 1477 it was occupied by Louis XI. of France, though his possession of it was contested by Maximilian, king of the Romans. It was, however restored to Maximilian by Charles VIII. in 1493, and on the division of the possessions of Charles V. of Germany, grandson of Maximilian, it fell to Spain, with which power it remained till 1678, when it returned to France.

FRANCHISE, in law, a right belonging to a subject of exercising a branch of the royal prerogative, either in virtue of a royal grant conferring such right upon him, or by prescription, which always presupposes such a grant. The right of being incorporated, and of holding fairs, ferries, &c., are among the most important franchises, which are, however, almost infinite. In politics it is the right of voting upon proposed legislative measures, where such measures are accepted or rejected by the people generally; or for representatives to a legislative assembly (the parliamentary franchise) or to a municipal body.

FRANCIA, Francesco. See Raibolini.

FRANCIA, Dr. José Gaspar Rodriguez, Dictator of Paraguay, was born in its capital, Assuncion, about 1758; died September 20, 1840. In 1811, when Paraguay threw off the Spanish yoke, he became secretary of the junta appointed by congress. In 1814 he was appointed dictator for three years, and in 1817 he was continued in authority for life. No sooner had he reached the goal for which he had been striving than he began to display the utmost tyranny in his administration. His enemies were imprisoned, and soldiers distinguished for their cruel and remorseless temper were selected for his bodyguard. His hostility was especially directed against Spaniards, ecclesiastics, and all religious bodies. His severities may in part be attributed to the fact that he was constitutionally subject to temporary fits of insanity. On the other hand, he improved both the industry and agriculture of the country, though often by very violent methods. He was kindly disposed towards foreigners, till they excited his jealousy by the culture of Paraguay tea, of which he made a state monopoly. After everything had been placed completely at his beck he seemed, in 1824, disposed to return to milder courses, but a new attack of his constitutional malady led him again to a renewal of his tyrannical proceedings; but as Paraguay had improved under his government, and the inhabitants had become reconciled to his tyranny, he was able to continue his system till his death.

FRANCIS I., King of France, was born at Cognac, September 12, 1494. His father was Charles of Orleans, count of Angoulême, and his mother Louisa of Savoy. He ascended the throne January 1, 1515. Francis determined to support his claims to Milan, and to take possession of the duchy. The Swiss, who had established Duke Maximilian Sforza in Milan, held all the principal passes; but Francis entered Italy over the Alps by other ways, September 15, 1515. After two days' fighting he gained a great victory over the Swiss who had attacked him in the plains of Marignano, in consequence of which Sforza now concluded a peace with Francis, surrendered Milan, and retired into France. On the death of Maximilian (1519) Francis was one of the competitors for the empire; but the choice fell on Charles of Austria, the grandson of Maximilian, henceforth known as the Emperor Charles V. From this period Francis and Charles were rivals, and were almost continually at war with one another. Both attempted to gain the alliance of England. With this view Francis invited Henry VIII. of England to an interview, which took place near Calais, between Guines and Ardres, in June, 1520. The magnificence of the two monarchs and their suites on this occasion has given to the meeting the name of the Field of the Cloth of Gold. This interview appeared at first to have its desired effect upon Henry, but this was destroyed by a meeting which took place between him and Charles V. at Gravelines. In 1521 war actually broke out between the two rivals, and was carried on in the north, in the south—where Francis hoped to recover from Spain, for the house of Albret, Upper Navarre, which had been seized by Ferdinand of Arragon—and in the territory of the Milanese. Francis was successful in the north, but was defeated in the south, and in Italy was forced to evacuate Milan and withdraw into the territory of the Venetians. He suffered a still greater loss in the defection of the Constable of Bourbon, whom he had unjustly and from unworthy suspicions deprived of his possessions in France, and who in revenge went over to Charles. The Great Constable defeated the French in Italy, drove them over the Alps, took Toulon, and laid siege to Marseilles. Francis flew to the defence of Provence, and, after delivering it, advanced into the Milanese, and laid siege to Pavia (1524). Here he was attacked by the emperor and entirely defeated, February 24, 1525. Francis himself was

made prisoner and taken to Madrid. He could recover his liberty only by signing the severe terms of the treaty of January 14, 1526, by which he renounced his claims to Naples, Milan, Genoa, and Asti, the suzerainty of Flanders and Artois, and promised to cede the Duchy of Burgundy and some other French fiefs. This treaty was never fully carried out, and the war was soon after renewed, an alliance, called the Holy League, having been formed between the Pope Clement VII., the King of France, the King of England, the Republic of Venice, the Duke of Milan, and other Italian powers, with the object of checking the advances of the emperor. In this war Rome was taken and sacked by the Constable of Bourbon (1527), and Italy was devastated, but Francis gained little either of fame or material advantage. In the 'Ladies' Peace' of Cambray, however, concluded in 1529, he was allowed to retain the Duchy of Burgundy. But this peace was of short duration. Milan, the constant object of contention, and the grave of the French, still excited the ambition of Francis. In 1535 he once more invaded Italy, and made himself master of Savoy. But the emperor made a descent upon Provence, and besieged Marseilles. At length, at a conference which took place at Nice between the king and Charles, through the mediation of the pope (1538), a truce of ten years was concluded. The emperor, who some time after passed through France to chastise the rebellious citizens of Ghent, in a personal interview with Francis promised to invest one of his sons with the sovereignty of Milan; but no sooner had he left France than he refused to fulfil his promise. In 1541 the imperial governor, Del Guasto, caused the French ambassadors, who had been appointed to Venice and Constantinople, to be murdered on the Po, and war was again kindled. Francis sent armies into Italy, Roussillon, and Luxembourg. Count d'Enghien defeated the Imperialists at Cerisoles in 1544, and rendered himself master of Montferrat. France now promised herself important advantages from an alliance with Sweden and Algiers, when her hopes were destroyed by the alliance of Charles V. and Henry VIII., king of England. The allies invaded Picardy and Champagne. The emperor rendered himself master of Soissons; the King of England took Boulogne. Fortunately for France the union of the Protestant princes of Germany against the emperor prevented him from following up his success, and inclined him to a peace, which was concluded at Crespy in 1544. Charles resigned all his claims on Burgundy, and allowed Francis to retain Savoy. Two years after peace was made with England. Francis died in 1547.

Francis I. possessed a chivalric and enterprising spirit. His generosity, clemency, and love of letters might have rendered France happy, had he been content to reign in peace. His protection of letters and the arts has caused many of his defects to be overlooked by posterity. He lived at the period of the revival of learning, and transplanted into France the remains which had survived the fall of the Greek empire. The arts and sciences first began to exercise a salutary influence on the character and manners of the French during his reign. In 1534 he sent Jacques Cartier on a voyage of discovery from St. Malo to America, the result of which was the discovery of Canada. Francis established the royal college, and laid the foundation of the library of Paris. Notwithstanding his many wars, and other great expenses, he left a flourishing treasury without debts.

FRANCIS II., King of France, son of Henry II. and Catharine of Medici, born at Fontainebleau in 1544, ascended the throne on the death of his father, July 10, 1559. The year previous he had married Mary Stuart, only child of James V., king of Scotland. During his short reign of seventeen months were sown the seeds of those evils which afterwards desolated France. The uncles of his wife, Francis, duke of Guise, and the Cardinal of Lorraine, held the reins of government. The latter stood at the head of the clergy, and had charge of the finances. The former had the direction of military affairs; and both used their power solely as a means of gratifying their pride and avarice. Antony of Bourbon, king of Navarre, and his brother Louis, prince of Condé, provoked that two strangers should govern the kingdom while the princes of the blood were removed from the administration, united with the Calvinists to overthrow the power of the Guises, who were the protectors of the Catholics. Ambition was the cause of the quarrel, religion the pretext, and the conspiracy of Amboise formed among the French nobility, especially the Calvinists, with the object of removing the king from the influence of the Guises, the first symptom of the civil war. The war broke out in March, 1560. In December of the same year Francis II., who was of a feeble constitution, and had long been out of health, died, leaving the kingdom loaded with debt, and a prey to all the miseries of civil war.

FRANCIS I., STEPHEN, Emperor of Germany, eldest son of Leopold, duke of Lorraine, was born in 1708. In 1723 he went to Vienna, and was invested with the Silesian Duchy of Teschen. On the death of his father, in 1729, he succeeded to the Duchies of Lorraine and Bar, of which, however, he did not long retain possession. In 1733 Stanislaus Leszczinsky was chosen king of Poland, on the death of Frederick Augustus of Saxony; but, being expelled from that kingdom, his son-in-law, Louis XV., demanded from the emperor, who had been his principal antagonist, an indemnification for him. As France had long laid claims to Lorraine, and repeatedly rendered herself mistress of it, it was stipulated, in the preliminary peace of Vienna (1735), that the Duke of Lorraine should cede that country to King Stanislaus, and, on his death, to France for ever; and that, in return, he should succeed to the Grand-duchy of Tuscany on the death of the grand-duke, John Gasto, the last of the Medici. This took place in 1737. In 1738 the provisions of the preliminary peace were finally ratified. In 1736 Francis had married Maria Theresa, daughter of the Emperor Charles VI. He was appointed general field-marshal and generalissimo of the imperial armies, and, in 1738, with his brother Charles, commanded the Austrian armies in Hungary against the Turks. After the death of Charles VI. (1740) he was declared by his wife co-regent of all the hereditary states of Austria, but without being permitted to take any part in the administration. After the death of Charles VII. he was elected emperor in 1745, notwithstanding some opposition, and crowned at Frankfort, October 4. He died at Innsbruck, August 18, 1765. For the memorable events of his twenty years' reign see MARIA THERESA.

FRANCIS I., JOSEPH CHARLES, Emperor of Austria (previously Francis II., emperor of Germany), King of Hungary, Bohemia, Galicia, Lodomeria, of Lombardy and Venice, &c., Archduke of Austria, &c., was born at Florence, February 12, 1768. He was the son of the Emperor Leopold II. and Maria Louisa, daughter of Charles III., king of Spain. He succeeded his father in the hereditary states of Austria, March 1, 1792, and was crowned king of Hungary, June 6, 1792, emperor, July 14, 1792, and king of Bohemia, August 5 of the same year. France having been declared an empire (May 18, 1804), he assumed (decree of August 11, and proclamation of December 7, 1804) the title of *hereditary Emperor of Austria;* and on the establishment of the confederacy

of the Rhine (July, 1806) he abdicated the crown of Roman Emperor and German King, and resigned the government of the German Empire. Francis I. was a man of very little intellectual strength, but a friend to justice. In the principal events of his reign but little influence must be attributed to him personally. He was educated at first under the eyes of his father, at Florence, and afterwards of his uncle, the Emperor Joseph II., at Vienna. At the age of twenty Francis accompanied his uncle on a campaign against the Turks, and in the following year received the chief command of the army, in which he was united with Laudon. After the death of Joseph (1790) he engaged in the administration of the government until the arrival of his father, on whose death, in 1792, he became emperor. France declared war against him (April 20, 1792), as king of Hungary and Bohemia. (See GERMANY.) Prussia at first took part with him, but afterwards concluded a separate peace with the republic. Still, however, he continued the war with energy. In 1794 he placed himself at the head of the army of the Netherlands. Animated by the presence of the monarch, they defeated the French (April 26) at Câteau and Landrecy, which they captured, and gained the bloody battle of Tournay (June 22). The states of Brabant, however, refused to grant him troops and money, and apprehending the misfortunes that afterwards befell him, he left Brussels, June 13, to return to Vienna. The Peace of Campo-Formio (October 17, 1797) procured him a temporary repose. In 1799 he entered into a new coalition with England and Russia against the republic; but in 1801 Russia and Austria were compelled to conclude the Peace of Lunéville. In 1805 war again broke out between Austria and France. But after the battle of Austerlitz, December 2, 1805, the terms of an armistice and basis of a treaty were settled in a personal interview between Francis I. and the Emperor of France, at the bivouac of the latter, and the peace of Presburg was signed on the 26th of the same month. In the war of Prussia and Russia against France he maintained a strict neutrality. Yet in 1809 he again took up arms against France, and in the Peace of Vienna, concluded on the 14th of October in that year, was compelled to surrender 42,500 square miles of territory; but at the same time a prospect of lasting peace with France was secured to Austria by Francis agreeing to the marriage of his eldest daughter, Maria Louisa, with Napoleon. The family tie that was to bind Austria and France could not appease the ambition of his son-in-law; and although the Emperor Francis, at the memorable interview at Dresden in 1812, united with him, yet this union was of short duration. In 1813 Francis I. entered into an alliance with Russia and Prussia against France, and was present to the close of the contest. In 1814–15 the greater part of the European sovereigns were assembled at the congress in his capital. He died on the 2d of March, 1835.

FRANCIS OF ASSISI, ST., was born at Assisi, in Umbria, in 1182, according to the legend, with a cross on his shoulder. His proper name was Giovanni Bernardone, but he afterwards received the name of Franciscus, on account of his facility of speaking French, which was necessary to the Italians in commercial affairs, for which he was destined by his father. Without indulging in such practices as were grossly vicious, Francis, whose character was naturally yielding, sociable, and generous, did not refrain from the pleasures of the world; but in the midst of this mode of life he beheld, in a dream, a quantity of arms, marked with the sign of the cross. He asked for whom they were destined, and was answered, 'for himself and his soldiers.' He then served as a soldier in Apulia, but was informed in another dream that his soldiers must be spiritual. He therefore sold the little property which he possessed, left the paternal roof, and at last, in 1208, clad himself in a brown tunic, girt with a cord, devoting himself thenceforth to a life of the most rigorous poverty. His followers were at first few, but when they reached the number of eleven he formed them into a new order, made a rule for them, and got it sanctioned, though at first only verbally, in 1210, by Pope Innocent III. In 1212 he received from the Benedictines a church in the vicinity of Assisi, which now became the home of the order of the Franciscans or Minorites. Francis afterwards obtained a bull in confirmation of his order, from Pope Honorius III. Some of his disciples being anxious to have the privilege of preaching in all places, without the permission of the bishops, he answered, 'Let us win the great by our humility and respect, and inferiors by our preaching and example; but let our peculiar distinction be to have no privileges.' In 1223 he went on a pilgrimage to Palestine; and in order to convert the Sultan Meledin, offered to prove the truth of Christianity by throwing himself into the flames. The sultan, however, declined this test, and dismissed him with marks of respect. After his return the order of St. Clara was founded under his direction, and a third order, called the Tertiaries, designed for penitents of both sexes, whether married or unmarried, who took upon them a vow to perform all religious duties compatible with their circumstances. He then withdrew to a mountain in the Apennines. There, if we may believe the legend, he beheld in a vision a crucified seraph, who perforated his feet, hands, and right side. On this account the order received the name of seraphic. Francis died two years after at Assisi, October 4, 1226. He was canonized by Pope Gregory IX. in 1228. His festival is on the 4th of October. Among his works (which have been published, among other places, at Cologne in 1849) the letters are the most remarkable. His life was written by one of his followers, Tommaso da Celano, the author of the hymn Dies Iræ, at the command of Pope Gregory IX., and was afterwards completed by three others. There are biographies in English by Mrs. Oliphant and Miss Lockhart, and that by Sabatier has been translated (1894). See FRANCISCANS.

FRANCIS OF PAULA, founder of the order of the Minims, was born in 1416 in the city of Paula, in Calabria. According to some accounts he was descended from a noble family in impoverished circumstances, but according to others he was of less illustrious origin. His father destined him for the monastic life. At the age of fourteen, renouncing his paternal inheritance, he withdrew to a cave in a rock, slept on the bare ground, and satisfied his hunger with the coarsest food. He had scarcely reached his twentieth year when so great a number of persons came to dwell in the solitude around him that he obtained from the Archbishop of Cosenza permission to build a convent and a church. Assisted by the inhabitants of the vicinity, the buildings were soon finished, and in 1436 ready to receive a numerous society. Thus was founded the new order, which was at first called the *Hermits of St. Francis*, and was confirmed in 1474 by Pope Sixtus IV. The statutes of the order were again confirmed by Alexander VI., under the name of the *Minims* (Latin, *minimi*, the least). The basis of the order was humility, and its motto *charity*. To the three usual vows Francis added a fourth, that of keeping Lent during the whole year; that is, abstaining not only from meat, but from eggs and every kind of food prepared with milk, excepting in cases of sickness. He practised still greater austerities himself. This extreme severity did not prevent the

increase of the order. The fame of his miraculous cures reached Louis XI. of France, then dangerously sick, who invited him to France. But it was not until he had received the commands of Pope Sixtus IV. that Francis set out for France, where he was received with the highest honours. If he was unable to prolong the life of the king, he at least aided him in dying with resignation. Charles VIII. and Louis XII. detained him, with his fraternity, in France. Charles consulted him on all affairs of importance, built him a monastery in the park of Plessis-les-Tours and also at Amboise, and loaded him with honour and tokens of veneration. Other princes also gave the Minims proofs of their favour. In Spain they were called the *Brothers of Victory*, in commemoration of the deliverance of Malaga from the Moors, which had been predicted by Francis. In Paris they were called *Bons-hommes*, the name '*bon-homme*' having been applied by the courtiers of Louis XI. to their founder. Francis, notwithstanding his rigorous mode of life, attained to a great age. He died at Plessis-les-Tours, April 2, 1507. Twelve years after his death he was canonized by Leo X., and the Roman Church celebrates his festival on April 2.

FRANCIS OF SALES, St. See Sales.

FRANCIS, Sir Philip, one of the many political writers to whom the authorship of Junius's Letters has been ascribed, was the son of Philip Francis, translator of Horace, and was born in Dublin on Oct. 22, 1740. Educated at St. Paul's School, he obtained a clerkship in the secretary of state's office, and in 1760 he went to Portugal with the British envoy. In 1762 he became chief clerk at the war office. He was dismissed, or relinquished the post, in consequence of a quarrel with Viscount Barrington, the minister of war; and in 1773 he went to the East Indies, where he became a member of the council of Bengal. In 1781 Francis returned to England, and in 1784 was chosen member of Parliament for the borough of Yarmouth in the Isle of Wight. On the impeachment of Warren Hastings, though his name did not appear as a manager of the proceedings against that gentleman, yet he actively supported them on every occasion, and was of great service to Burke in preparing the charges. Francis hoped for a time to become governor-general of India, but had ultimately to be content with a knight-commandership of the Bath. He died in London on Dec. 23, 1818. He published several political pamphlets, and the authorship of the famous Letters of Junius has been attributed to him upon what is now generally regarded as unsatisfactory evidence. Macaulay was a strong advocate of the claims of Sir Philip Francis to the authorship. See Junius, and consult papers in the Athenæum for 1899 by W. Fraser Rae.

FRANCISCANS, the designation borne by the members of the three great religious orders founded in the thirteenth century by St. Francis of Assisi. The first of these orders is that of the Friars Minor, known also as the Greyfriars, and in France as the Cordeliers. The second order is that of the Poor Clares, called in Italian *Povere Donne* (Poor Ladies), and in France the Clarisses. The third order is that of Penance, or Tertiaries.

I. Francis, keenly alive to the evils which in his day seemed to threaten the very existence of the church and society, strove to counteract their baneful influence by establishing an order, the members of which were to observe the most absolute poverty, and to be devoted to the service of the church. The goal which he aimed at was to reproduce the ideal of the divine life on earth, therefore neither he nor his were to possess anything temporal, but were to go about doing good and preaching to all the world the kingdom of heaven. A little band of disciples to the number of seven, aglow with a similar enthusiasm, gathered round the saint, and the little chapel of the Portiuncula near Assisi was the place where the order was first planned. It was truly a humble origin, an insignificant beginning, but Francis had a presentiment of the future world-wide extension of his order. In 1210 he obtained from Innocent III. a verbal approbation of the rule he had drawn up for it. Forthwith it appeared how accurately he had gauged the wants of his age, for his order sprang at a bound into popular favour. So rapid was its growth, that ten years afterwards, at a chapter held near Assisi, more than 5000 of his religious assembled, and not half a century had elapsed when they counted missionaries in every known country, as may be learned from a bull of Alexander IV. in 1258. In 1260, when a chapter presided over by St. Bonaventure was held at Narbonne, the order had 1400 houses. At the dissolution of the monasteries in England there were 65 houses of Franciscans, and even in 1680, in spite of severe losses in Protestant countries, the order numbered 100,000 members. The order is ruled by a general minister, who, with his council or *definitorium*, resides at Rome. It is divided into provinces, to govern which provincials are elected. Each province is composed of a certain number of houses or convents, whose superiors are termed guardians. Owing to the absolute nature of the poverty prescribed by the second rule drawn up for the first order, and approved by Honorius III. in 1223, some of St. Francis' immediate followers showed tendencies inimical to it even in the saint's lifetime. After his death these tendencies became more marked, and were covertly connived at and effectively encouraged by the second minister-general, Elias of Cortona. This was the rift in the lute, which widened as time went on. Some zealous upholders of the purity of the rule, such as St. Antony of Padua, Adam de Marisco, Cæsarius or Cesarinus of Spire, protested against all innovations, and laboured strenuously to maintain intact their sacred inheritance, receiving the distinctive name of *Cesarines*. After vainly seeking to redress the existing abuses, they returned to the body of the order in 1256. Other reforms were initiated, such as that of Peter of Macerata, 1294; that of Philip of Majorca, 1308; that of John of Vallées, 1336; and others. They met with varying success, until in 1415 a final split took place, one section of the order adopting the mitigations which had been introduced in the matter of poverty, this being the bone of contention all through. They became known as the *Conventuals*, while the members of the other section were called *Observants*, as observing faithfully the Franciscan traditions. These latter still adhere strictly to the original austerity of their rule. St. Bernardine of Sienna, St. John Capistran, and St. James de la Marcha were mainly instrumental in promoting the interests of the Observance. In 1517 Leo X. issued his famous bull, *Ite et vos in vineam meam*, decreeing that a general minister of the whole order was to be chosen from amongst the Observants, and that the Conventuals were to elect a master-general. The Observance, however, did not satisfy the zeal of some, and thus we find certain groups, such as the Reformati, originating in Italy; the Alcantarines, or those who follow the reform of St. Peter of Alcantara, in Spain; and the Recollects. (Negotiations are now in progress to abolish these minor differences, which are more apparent than real.) There were now the two great families of the first order, the Observants and the Conventuals, these latter being governed, as said above, by a master-general, and notwithstanding their dispensation in regard to poverty, they have always rendered

important services to the church. The great Pope Sixtus V. was himself a Conventual.

In 1525 there arose a third family, known at first as the Hermits of St. Francis, and later as the Capuchins, because of the shape of their *capuce* or hood, which was larger and longer; besides, they cultivated a beard. Matthew Baschi inaugurated this branch, which differs only externally from the Observance. In 1536 Paul III. approved their constitutions, placing them under sundry restrictions, which have been gradually removed.

The Franciscans did not devote themselves exclusively to the apostolic life. From the first they took an active and leading part in the study of Holy Scripture, and in all the branches of sacred and secular learning. They have filled with honour the first chairs in the most celebrated universities. Such great names occur amongst them as Alexander of Hales, John de la Rochelle, St. Bonaventure (the Seraphic Doctor), Francis Mayronis, and Nicholas de Lyre. In England, during the centuries immediately preceding the Reformation, there were 67 friars professors at Oxford and 73 at Cambridge, amongst them being Adam de Marisco, Duns Scotus (the Subtle Doctor), Roger Bacon, the pioneer of the modern discoveries in the physical sciences, and William of Occam, called 'the Razor'. Nuncios, legates, archbishops, cardinals, and popes have been chosen from among the Franciscans.

II. The Franciscan nuns, or Poor Clares. In 1193 Clare was born at Assisi, of the noble family of the Scifi, counts of Sassorossa. On hearing of the wonderful life of her fellow-townsman Francis, she became inflamed with the desire of consecrating herself to God under his direction. In 1212 she fled to Portiuncula, and refused to return home. Her sister Agnes and other ladies soon joined her. They were located in a convent of Benedictine nuns, and afterwards at St. Damien's in Assisi, where they followed, for a time, a rule of life drawn up by Cardinal Hugolin. Francis, however, prepared another rule for them, on similar lines to the one approved for his first order; and in 1246 Innocent IV. gave his approbation to this. The new order quickly spread throughout Italy on to France, Spain, and Germany. After Clare's death certain modifications were introduced, and Urban IV. in 1264 approved another rule substantially agreeing with, but somewhat mitigated from, that of St. Francis. The great majority of Poor Clares elected to follow it, and were thenceforward called Urbanists. The first convent of Franciscan nuns or minoresses founded in England (1293) was outside Aldgate, in the east of London. The house was known as the 'Minories', a name which the locality still retains. In 1436 a reform was started by St. Colette of Picardy, which reverted to the original rigour of the rule. The nuns adopting this stricter life were called Colettines. Other reforms, such as gave rise to the Conceptionists and the Annunciades (this latter founded in 1561 by Jane of Valois, queen of France), date from this century. Julius II. early in the 16th century placed the Poor Clares under the government of the Franciscans of the first order. In Hélyot's time (who died in 1716) the order numbered 900 convents, and at present there are five in England and six in Ireland.

III. The order of Penance, or Tertiaries. Such was the influence of Francis' preaching and example, that many who were bound by domestic and social ties wished to break them and follow in his footsteps. In 1221 he devised a means whereby such persons could satisfy their pious desires and yet remain in the world. This produced a middle term between the religious state and the secular. The members of the new body, both men and women, were bound to dress more soberly, fast more rigorously, pray more regularly, lead more edifying lives than ordinary persons living in the world. Later on some of them added vows and lived in community. These were known as the Cloistered Tertiaries. Thus the third order is both religious and secular. Moreover, there are Tertiaries, lay-brethren, dwelling in Franciscan houses of the first order. Leo. XIII., the late sovereign pontiff, himself a Tertiary, so far modified the rule of the secular third order, and adapted it to modern requirements. It has multiplied in an extraordinary manner of late, and men in all ranks and professions belong to it.

FRANCIS XAVIER, St. See Xavier.

FRANCO-GERMAN WAR OF 1870–71. The remote causes of this war are to be sought for in the mutual jealousy which had existed between France and Prussia for some years previously, and which had been strengthened on the side of France by the events of 1866, which secured to her rival the unquestioned leadership in Germany. The immediate occasion of the war was an offer made in June, 1870, by General Prim, then at the head of affairs in Spain, of the crown of that country to Leopold of Hohenzollern, a prince belonging to the reigning house of Prussia. It was thought in France that the acceptance of this offer would endanger the balance of power in Europe, and more particularly would threaten the safety of France, by putting Prussia in a position to attack it both in the east and in the south. Accordingly, the government of Napoleon III. demanded of the King of Prussia that he should forbid the candidature of the prince, and when the prince voluntarily retired from his candidature, still insisted that this renunciation should be formally made by the king, and a guarantee given that the candidature would not be revived. This demand was refused, and a formal declaration of war by France against Prussia was received by Count Bismarck, the chancellor of the North German Confederation, on the 19th of July. The war was welcomed by both sides with equal enthusiasm. The French (with the exception of a small minority) were especially jubilant, and anticipated the cries of victory by shouts of 'A Berlin, à Berlin!' Preparations had begun to be made by both belligerents even before the date of the formal declaration of war, and were actively carried forward on both sides. The French were the first in getting their troops to the frontier; but in this they were only apparently in advance of the Germans, for it soon became manifest that the French army, instead of being in a complete state of readiness for war, as the minister of war had declared, was defective in almost everything essential to the equipment of an army, and that the munitions of war, and other equipage, without which the army could not move, could not be sent after it with the requisite despatch, and after all were sent in greatly insufficient quantities. Owing to the prevalence of the system of paying for substitutes who never appeared, and were yet registered as belonging to the army, it was likewise discovered that the numbers of the army did not reach anything like the amount at which they were represented in the official estimates.

In Germany everything formed a complete contrast to this state of matters. There the arrangements for mobilizing the army, which had previously been tested in Prussia in 1864 and 1866, were again found to work admirably. Each section of the army was completely organized in the head-quarters of the district which it occupied in time of peace, and was only sent to the frontiers after being furnished with everything it required. In this way the German army, although later than the French in reaching the scene

of war, was ready to commence active operations as soon as all the sections had arrived. In addition to this Prussia, against which country alone the war had been declared, was not only joined according to treaty by all the states of the North German Confederation, but also by those of the South, upon whose neutrality, perhaps even upon whose alliance, Napoleon and the French had counted. The whole of Germany north and south was thus in arms, and was able to muster forces far outnumbering those of the French. While the whole French army brought into the field at the commencement of the war numbered no more than 310,000 men, the troops of the Germans in the field amounted in all to 477,000, to which must be added strong reserves ready, with the exception of such as were necessary to protect the interior and to resist a threatened landing on the north coast by the French fleet, to be brought to the scene of war at any time, giving a total strength on the side of the Germans of more than 1,000,000 of men. In these circumstances the result could scarcely be doubtful.

The German forces were divided about the end of July into three armies, one of which, known as the First Army, had its head-quarters at Trèves under General Steinmetz; another of which, known as the Second Army, occupied the Bavarian Palatinate under Prince Frederick Charles; while the Third Army, under the Crown-prince of Prussia, was stationed in Northern Baden. The cavalry of each army, instead of being attached in separate divisions to each of the corps d'armée composing the army, were in this war massed together into one body, and in this formation rendered very important services during the war. The commander-in-chief of the whole forces was King William of Prussia, who was supported by a staff of general officers, with Von Moltke at their head. The French army, under Napoleon himself, had its head-quarters at Metz, and two advanced divisions were stationed on the borders of France and Germany, the one in the north on the Saar, under General Frossard, the other further south at Weissenburg, under General Douay. The first overt act of war was a small outpost affair which took place on the 2d of August, in which a part of the northern division of the French army, in the presence of Napoleon himself and the prince imperial, compelled a few Prussian troops belonging to the First Army, after some hours' firing, to evacuate Saarbrücken. After this Von Moltke assumed the offensive. His plan was to unite the three armies in the line of the Moselle in order to attack the enemy's centre with the view of obtaining the shortest line of operations in the direction of Paris. With this object the crown-prince was obliged to move his army northwards, and in so doing came into contact with the most advanced part of the southern division of the French army at Weissenburg, where the first serious engagement of the war was fought (August 4), which resulted in a victory for the Germans. Two days later (August 6) the crown-prince found the French under Marshal Macmahon still more strongly posted at Wörth, and a battle again followed with results still more disastrous for the French, who were driven from the field in utter rout. In consequence of this victory the whole of Upper Alsace fell into the hands of the Germans. The crown-prince pressed forward, leaving only a detachment of his army behind under General Werder for garrisons and sieges, especially for the siege of Strasburg. On the same day (August 6) the first and second German armies had attacked and totally defeated, although with terrible losses to themselves, the northern division of the French army at Forbach, so that the French army was now in retreat along its whole line, the southern half in the direction of Nancy, and the northern of Metz. The object of the Germans was now, in the first place, to overtake the latter army (the command of which was given to Marshal Bazaine on the 9th), and prevent it from effecting a union with that of Macmahon, which, without attempting to make a stand at Nancy, still continued to retreat upon Châlons. In this pursuit General von Moltke made a very striking and effective use of the cavalry at his disposal. He ordered it all to the front, where it served to conceal the movements of his own armies, while at the same time it was able to furnish him with full information as to those of the enemy, and facilitated the advance of the troops in many ways, summoning towns to surrender, imposing requisitions, obtaining forage, &c. It also made prisoners of numerous stragglers, or detached bodies too weak to resist any troop of cavalry that might suddenly appear. They were at the same time always ready to bear a part on the field of battle when they were required. Hence the German cavalry, especially the Uhlans, were regarded by the French with great dread. The army of Bazaine was overtaken by those of Steinmetz and Frederick Charles on the 14th of August, when the engagement at Courcelles took place, in which the Germans were again victorious. This had the effect of detaining Bazaine for a short time; but on the 15th of August the road to Verdun was still open to him, and he began to move in that direction, but made very little progress on account, it is said, of difficulties of transport. Meanwhile the second German army, and a large part of the first, had marched a little way up the Moselle, then crossed the river, and returned northwards in order to attack Bazaine in flank. On the 16th the French were overtaken, and the battle of Vionville, or Mars-la-Tour, fought, which was followed on the 18th by that of Gravelotte. The last-mentioned battle is claimed by both sides as a victory; but however this may be, the consequence of the battle was that Bazaine withdrew his army under the protection of the fortifications of Metz, so that his retreat to Verdun was effectually cut off, and all the results of victory accrued to the Germans. Metz was now surrounded. For this purpose the first and a part of the second army was set apart, and these were strengthened by fresh reinforcements drawn from France. The whole of the forces appointed to carry on the siege were placed under the command of Prince Frederick Charles.

Meantime the Crown-prince of Prussia had advanced as far as Nancy, and was there awaiting the result of the battles around Metz. He had still the army of Macmahon to deal with, which had now reached Châlons, where it had been reorganized and strengthened to such a degree that the army of the crown-prince was no longer able to cope with it unaided. Accordingly, out of three corps d'armée belonging to the second army, a new army was formed, which was afterwards called the army of the Meuse, and was placed under the Crown-prince of Saxony. About the 20th of August these two armies set out on parallel routes (with the cavalry as usual in front) in the direction of Châlons in order to engage the army of Macmahon, which it was expected would now retreat on Paris. Instead of this, however, Count Palikao, minister of war at Paris, issued an order to Marshal Macmahon to strike northwards to the Belgian frontier that he might thence make a descent upon Metz and relieve Bazaine. This was a movement that above all things demanded celerity of execution; but so far was this requirement from being fulfilled that ten days were occupied by the French in their march from Reims to Beaumont, so that they were overtaken near the latter place before the end of August. The first contact with the enemy took place on the 27th of August at Buzancy, where an

advanced detachment of cavalry belonging to the army of the Meuse dispersed a body of French chasseurs, and on the days immediately succeeding a number of engagements and strategic movements ensued, the result of which was that on the 1st of September the army of Macmahon was surrounded at Sedan by a force of overwhelmingly greater numbers, and on the following day both army and fortress surrendered by capitulation. A corps which had been raised in Paris, and sent under Vinoy to the assistance of Marshal Macmahon, arrived too late to be of any service, and hastily returned back to Paris. On this occasion 50 generals, 5000 other officers, and 84,000 private soldiers became prisoners of war. Among these was Napoleon III., who was unexpectedly found to have been present with the army of Macmahon. He had a personal interview on the day after the battle with King William of Prussia, who assigned to him Wilhelmshöhe, near Cassel, as his place of residence during his captivity.

One of the first consequences of this crushing defeat was an outburst of rage on the part of the Parisians against the Napoleon dynasty, which on the 4th of September was declared by Gambetta and some members of the corps législatif belonging to the Left to be dethroned. The same members then proceeded to the Hôtel de Ville and proclaimed a republic. A government of national defence was then formed, at the head of which was placed General Trochu. Meantime France had no available army which was strong enough to stand its ground for an instant before the German armies that were now enabled to continue their march upon Paris. The investment of the city was completed on the 19th of September, a sally under General Vinoy having been repulsed on the same day. A day or two before a delegation from the central government had escaped from Paris and established themselves at Tours, where they were followed on the 9th of October by Gambetta, who had made his escape from Paris by a balloon on the 7th, bringing with him extraordinary powers. It was not till about the beginning of October that the French were able to organize a new army after the loss of that of Macmahon, and some time yet elapsed before any attempts could be made to raise the siege of Paris by an attack on the besieging army from without. The depot troops and the forces which had been brought from Algiers formed the nucleus of the new armies, the great mass of which consisted of raw and undisciplined levies. But the great difficulty which had to be overcome was not so much the want of trained soldiers as the want of war material of all kinds. It is said that after Sedan there were only six field-pieces in France in a condition enabling them to be brought into the field, and there was a like deficiency in other things necessary to the equipment of an army, and it is thus easy to account for the delay which allowed the Germans to take up their positions before Paris with so little opposition. By the beginning of November the war in the open field had been resumed in three different centres: on the Loire in the neighbourhood of Orleans, in the north, and in the south-east. The army of the Loire was the first of the new armies that was brought into the field. It was placed at first under the command of General La Motte Rouge, who was soon after superseded by General Aurelle de Paladines. Under the latter general it obtained some decided successes over the inferior forces of the Germans, who after occupying Orleans were compelled to evacuate it, and on the 7th of November were defeated under Von der Tann at Coulmiers. These successes, however, Aurelle de Paladines was unable at the time to follow up; and while he contented himself with occupying Orleans, the army opposed to him received strong reinforcements. These consisted in the troops of the Second Army under Prince Frederick Charles, which had been, as has been already mentioned, occupied with the siege of Metz, and rendered available for other services after the capitulation of that fortress with the army of Bazaine on the 28th of October, and had been ordered to proceed by forced marches to the support of Von der Tann. After his arrival the advance of the army of the Loire was checked, and on the 4th of December Aurelle de Paladines suffered a severe defeat near Orleans, in consequence of which his army was divided, one part retreating westwards and the other in a south-easterly direction towards Bourges. The former became the army of the West, and was placed under General Chanzy; and the latter, the command of which was given to General Bourbaki in place of Aurelle de Paladines, became the army of the East. On the succeeding day the delegation of the government at Tours removed to Bordeaux. When this division took place on the French side the Germans likewise divided their troops, one part pursuing Chanzy and the other Bourbaki; but when it was found that the former had the stronger army, the main body of the Germans, under Prince Frederick Charles, was sent to oppose him. Only a small detachment from the army of Frederick Charles was left to watch the movements of Bourbaki, and when it was known that his army was destined for the east, other arrangements were made at the German head-quarters for checking his operations, and the whole strength of the Second Army was employed against General Chanzy. The latter now found himself too weak to make any effectual resistance. He displayed, indeed, considerable energy and military skill, but was nevertheless gradually pushed from position to position, and on the 12th of January was totally routed at Corneille and St. Croix, and on the same day Le Mans was taken. Chanzy afterwards collected and reorganized the ruins of his army, but it never again came into action.

A few days later, on the 19th of Jan., the army of the North suffered a final defeat at St. Quentin. This army had been formed soon after that of the Loire, and had at first been given to General Bourbaki, afterwards to General Faidherbe. Owing to its miserable condition on its formation, it was impossible to attempt any serious operations with it till far on in November. By this time the fall of Metz had enabled General Moltke to revive the command of the First Army, which he gave to General Manteuffel, with orders to operate against Faidherbe in the north. In the various battles which ensued (Amiens, Nov. 27; Hallue, Dec. 23; Bapaume, Jan. 3; Beauvais, Jan. 18; St. Quentin, Jan. 19), although the victory was nearly always claimed by Faidherbe, yet Manteuffel, and afterwards General Goeben, who was appointed to succeed Manteuffel in the command of the First Army after the latter had been appointed to the command of a new army, called the Army of the South, were always at least successful in preventing Faidherbe from making a descent on the German lines at Paris; and his last failure, at St. Quentin, concluded the offensive operations of the Army of the North.

In the east and south-east likewise the results of the war were equally, or, indeed, more disastrous for the French. There from the beginning the defiles of the Vosges had been occupied by a feeble corps under General Cambriels; and afterwards in Burgundy a number of irregular forces had been collected and placed under the command of General Garibaldi, who had offered his services to the French Republic. On the 27th of Sept. the capitulation of Strasburg set free for further operations the *corps d'armée* of General Werder, who at once occupied the Vosges,

and compelled General Cambriels to retire upon Besançon. Not being strong enough to attack that fortress, he then proceeded against Dijon, which was captured on the 31st of Oct. In the following month the troops of Garibaldi were driven back in such disorder that it was scarcely possible to reorganize them. Affairs were in this position when General Werder was informed, about the end of December, that the army of Bourbaki had been ordered to the east, and was then proceeding towards the frontiers, probably with the intention of invading Germany or of cutting off the communications of the German army. It was with the view of checking this movement of Bourbaki's that the Army of the South had been formed and intrusted to the command of Manteuffel, and this army was now hastening to overtake that of Bourbaki. As soon as he heard of this movement Werder judged it necessary at once to quit Dijon, and, collecting all his small force, to take up a strong position in the route of Bourbaki's army, which now amounted to about 150,000 men. The position he fixed on was at Héricourt, on the Lisaine, between Montbelliard and Belfort, where on the 15th, 16th, and 17th of January, he successfully resisted the repeated attacks of the French army. Manteuffel, on approaching the scene of action, finding the enemy already beaten, did not at once effect a union with the corps of Werder, but hastily pushed his troops forward to Pontarlier, on the Doubs, so as to intercept the retreat of the army of Bourbaki, and leave no escape open except across the Swiss frontier. After a few sharp engagements between the rear-guard of the French and the van of the Germans, the remains of Bourbaki's army, now in a pitiable condition, and reduced to only 84,000 men, saved themselves by taking refuge on the 1st of February in Switzerland, where they were disarmed and remained till the conclusion of the war.

A few days before this the ultimate event of the war had been determined by the fall of Paris. The city had held out for a much longer period than even the most sanguine on the side of the French had at first expected that it would be able to do. Sallies were made at intervals by the garrison (Oct. 12, Oct. 21, &c.; Jan. 13, 14, 15, and 19), but not sufficiently often or in sufficient strength to have any decisive effect. On the failure of the last sally, which took place on the west side from Mont Valérien on the 19th of Jan., on the same day on which General Faidherbe, according to previous arrangement with the government of Paris, made his last attempt to reach Paris from the north, and was defeated at St. Quentin, General Trochu resigned. He was succeeded by Leflô as head of the government of defence, and by General Vinoy as commander of the troops of Paris; but by this time the city, which had already for about three weeks been suffering bombardment from the Germans, was in such a desperate condition that the government could no longer help seeing that a capitulation was inevitable. The terms were settled on the 28th of Jan., the chief being that all the forts around Paris should be immediately handed over to the Germans, and that the city should pay a contribution of 200,000,000 fr. (£8,000,000). An armistice of three weeks was at the same time concluded, to allow of the election and assembling of a National Assembly to decide upon war and peace. This armistice, however, was not to extend to the scene of war in the south-east until a separate arrangement had been made regarding it. Here the fortress of Belfort still held out, but at last, on the 16th of Feb., it agreed to capitulate. The garrison, on account of its gallant defence, was allowed to march out with full military honours. On the same day the armistice became general. The fortress of Bitsch (Bitche), in the department of Moselle, did not surrender till after the conclusion of the preliminaries of peace.

Meantime the elections for the assembly had taken place on the 8th. It met at Bordeaux, and on the 17th it appointed M. Thiers head of the executive, and on the 21st he arrived at Versailles along with a diplomatic commission to negotiate for peace. After the armistice had been thrice prolonged the preliminaries of peace were signed at Versailles on the 26th of Feb., and accepted by the assembly at Bordeaux on the 1st of March. The principal terms were the following:—1. That France should cede to Germany one-fifth part of Lorraine, including Metz, together with the whole of Alsace except Belfort and the surrounding district. 2. That France should pay to Germany a war indemnity of five milliards of francs (£200,000,000). 3. That certain departments of France should remain in the occupation of the Germans, and should not be fully evacuated until after the payment of the whole indemnity. The definitive treaty of peace, which was signed at Frankfort on the 10th of May and ratified on the 21st, confirmed in all essential particulars the preliminaries of Versailles. The last instalment of the war indemnity was paid on the 5th of Sept. 1873, and France completely evacuated by the Germans on the 13th of the same month.

FRANÇOIS, St., a town in the French West Indies, in the island of Guadeloupe, on the south-east coast of Grande Terre, 7½ miles east of St. Ann. It has extensive sugar and cotton works. Pop. about 6000.

FRANCOLIN, a genus of birds belonging to the same family with the partridge (Perdicidæ), and to the order of the Gallinaceæ; according to others, to the sub-order Gallinacei of the order Rasores, or Scratchers. They resemble the partridge in many respects, but are distinguished by a longer and stronger bill, a longer tail, and usually by having one or more strong and sharp horny spurs on the tarsi. Their habits are almost the same as those of the partridge, but they prefer to live on marshy plains in the neighbourhood of woods, where they roost during the night. The only member of this genus known in Europe is the *Francolinus vulgaris* (*Tetrao francolinus*, Linn.), which is characterized by a red band round the neck, and red feet. It is found in the south of France, Sicily, Cyprus, and the southern part of the Continent generally. The other species belong to Africa, Asia, and Oceania. The *Francolinus Ponticerianus* is very common in the Deccan, where it is called a partridge. The Sanguine Francolin (*Ythaginis cruentus*) is one of the handsomest birds to which the name is applied. It is found in the Himalayas, in the regions of Nepaul and Sikkim, often at a very considerable elevation. It is distinguished by its spurs being more numerous than in other birds of the same name, and by the deep blood-red colour of the chin and throat of the male.

FRANCONIA (in German, *Franken*, so called because early in the sixth century it was colonized by Franks), a district of Germany lying to the east of the Rhine, and traversed by the Main. After the dismemberment of the Carlovingian Empire this district became attached to the German division, and ultimately formed one of the grand-duchies of Germany. Between 1024 and 1125 it furnished a series of emperors to Germany. (See GERMANY—History.) It was one of the ten circles into which the empire was divided by Maximilian I. in 1512. Its capital was Nuremberg. In 1806 it was partitioned among Würtemberg, Baden, Hesse-Cassel, the Saxon duchies, and Bavaria. The last received the largest share,

and still retains the name in the three circles of Upper, Middle, and Lower Franconia. The first, nearly corresponding to the former circle of Upper Main, has an area of 2702 square miles; the second, including the greater part of the former circle of Rezat, has an area of 2925 square miles; the third, including, with the addition of Aschaffenburg, the whole of the former circle of Lower Main, has an area of 3243 square miles. The name of Franconia has been rendered familiar to the traveller and the geologist by its picturesque scenery, which has procured for part of it the name of Franconian Switzerland, and by its caverns, filled with fossil bones, among the most remarkable of which is König Ludwig's Höhle (King Louis's Cave), between Baireuth and Muggendorf.

FRANCONIAN WINES, German wines produced in Bavaria, in the district of Lower Franconia. The best sort is the *Leistenwein*, which, after it has acquired a certain age, is superior to any other German wine for its agreeable aroma. Another sort is the well-known *Steinwein*. Other good wines are the *Heiligegeist*, *Hörstein*, and *Horfenwein*; the *Kalmuth*, a liqueur wine; the *Schalksberger*, &c. The chief trade in these wines is carried on at Würzburg. A considerable quantity of sparkling wine is also made.

FRANEKER, a town in Holland, in the province of Friesland, on a canal communicating with the sea at Harlingen, 10 miles W.S.W. of Leeuwarden, in a fertile district. It was the seat of a university from 1585 to 1811, and was long celebrated as a school of theology. It has a town-hall, a botanic garden, and an athenæum, with museum and library. The industries are chiefly connected with silk and wool. It is an old place, having obtained town rights in 1191. Pop. (1899), 7114.

FRANGULIN ($C_{22}H_{22}O_9$), is extracted from the root, bark, fruit, and seed of the berry-bearing alder (*Rhamnus frangula*). It is a bright yellow, silky, crystalline mass, without taste or smell, which fuses on heating, and can be sublimed in golden needles. It is not soluble in water, and though soluble in hot alcohol separates very completely on cooling. It dissolves in alkalies with a purple colour, and is decomposed by sulphuric acid with a succession of colours. It forms lakes with metallic hydrates, and dyes silk, wool, and cotton. In its chemical constitution it is a glucoside, and it is probably the same as *cascara sagrada* (which see). When treated by hydrochloric acid, or with dilute alkalies, it splits up into glucose and *frangulinic* acid. This acid forms a yellow crystalline mass, but by slow crystallization from alcohol it has been got in red needles. It dissolves with difficulty in water and ether, readily in alcohol. It combines with the alkalies and forms splendid red solutions. It also yields substitution products with bromine and with nitric acid.

FRANK, a name applied in the East to Christians, probably because the French, descendants of the German Franks, particularly distinguished themselves in the Crusades.

FRANK. See FRANKING LETTERS.

FRANKALMOIGNE, literally 'free alms', a mode of tenure in England, according to which a religious corporation, whether sole or aggregate, held lands of the donor for themselves and their successors for ever, without being required to perform any but religious services, such as praying for the souls of the donors. This was a mode of tenure among the Anglo-Saxons, and was continued under the Normans. It subsists even at the present day, this tenure and that by divine service having been specially exempted from abolition by 12 Car. II. cap. xxiv. Most of the lands of the parochial clergy are regarded as still held by this tenure. Tenure *by divine service* was somewhat different from frankalmoigne, the services in this case being definite and distinctly specified (as so many masses, &c.).

FRANKENBERG, a town of Germany, in the Kingdom of Saxony, on the Zschopau, 40 miles S.E. of Leipzig. It is regularly built, and carries on extensive manufactures of woollens, cottons, and silks; has dyeworks, printfields, bleachfields, spinning-mills. Pop. (1900), 12,726.

FRANKENHAUSEN, a town of Germany, in the principality of Schwarzburg-Rudolstadt, on an artificial arm of the Wipper, 31 miles N.N.E. of Gotha. It has tolerably spacious streets, with houses in a great measure rebuilt after a conflagration in 1833; salt-work and brine bath; manufactures of musical instruments, &c.; and in the vicinity lignite workings and quarries. It was the scene of the defeat of Thomas Münzer and the Anabaptists in 1525. Pop. (1900), 6383.

FRANKENIACEÆ, a natural order of plants belonging to the thalamifloral dicotyledons, represented in Britain only by *Frankenia lævis*, the sea-heath of the eastern coast of England. This plant is a procumbent sub-shrub, with numerous fascicled leaves, and sessile flowers embedded amongst them. The flowers have six stamens, a stigma cleft in three, and a superior three-celled fruit with many seeds.

FRANKENSTEIN, a town in Prussia, in the province of Silesia, on a height, 36 miles S.S.W. of Breslau. It consists of the town proper, surrounded by walls with four gates, and of four suburbs; and has an old castle, a Roman Catholic and a Protestant church, and some manufactures. It was almost entirely destroyed by fire in 1858. Pop. (1900), 7890.

FRANKENTHAL, a town of Bavaria, in the Palatinate, on the Isenach, and connected by a canal with the Rhine, 33 miles S.S.E. of Mainz. It is well built, and has manufactures of machinery, boilers for steam-engines, corks, musical instruments, beet-root sugar, a bell foundry, and a trade in wine, iron, and wood. It was founded in 1562, round an Augustinian monastery, by Protestant emigrants from Flanders. Pop. (1895), 14,445; (1900), 16,849.

FRANKFORT, the capital of Kentucky, United States, picturesquely situated on the Kentucky river, about 30 miles W.N.W. from Lexington. The chief buildings are the state-house, the state prison, and a fine Oddfellows' temple. There are flour-mills, a cotton-mill, carriage and furniture factories, a pottery, distilleries, &c., and a trade in lumber. It became the capital of the state in 1792. Pop. (1900), 9487.—There is also a town of this name in Indiana, capital of Clinton county, 46 miles north-west of Indianapolis. It is situated in a fertile district, and manufactures railway-cars. Pop. (1890), 5919; (1900), 7100.

FRANKFORT-ON-THE-MAIN (German, *Frankfurt am Main*), a town of the German Empire, in the Prussian province of Hesse-Nassau, 20 miles N.E. of Mainz. It consists of the town proper, situated on the right bank of the Main, the suburb of Sachsenhausen on the left bank, and (since 1895) the suburb of Bockenheim, forming a north-west continuation of Frankfort. The city boundaries also embrace a considerable area beyond that occupied by streets. The river is crossed by numerous bridges, of which the oldest is a 14-arched structure of stone dating from 1342. Among the others are a suspension-bridge for foot-passengers and two railway bridges. From whatever side the town is approached, but more especially when viewed from the Mühlberg or Sachsenhausenberg on the south, it has a beautiful appearance. The environs are covered with villas, and the old walls, ramparts, and stagnant ditches having been removed, the space occupied by them and the glacis has been planted, and forms fine promenades, surrounding the

old or inner town. Both banks of the river are lined by spacious quays, and the town stretches east to west along the river on the north or right side for about 2000 yards. Fronting the quay here is a range of magnificent houses, well deserving the name of palaces. Immediately behind it is the Old Town, consisting generally of narrow streets and lanes. These, however, have been recently much altered, so that the famous Juden Gasse, or Jew's Street, for instance, has almost entirely disappeared, except the ancient house belonging to the Rothschilds. The more modern streets in this quarter, such as the Zeil, Neue Mainzer St., Kaiser St., &c., have many handsome buildings. The Rossmarkt is the largest open space in the city, and to the south of this, in the Grosser Hirschgraben, is the house where Goethe was born. The Römerberg, one of the squares in the town, is perhaps the richest in historical recollections, and possesses, in the Römer or town-house, a venerable structure, with which a description of the public edifices may properly commence. It was erected about the year 1406, and continuing to undergo successive alterations and additions, was not completed in its present form till 1740. Its chief interest lies in its interior. In one of its halls, the Wahlzimmer, the electors of the empire met and made their arrangements for the election of the emperor, and the Senate of Frankfort held its sittings. In another, the Kaisersaal, the emperor was banqueted after his election, and waited on at table by kings and princes. This hall is embellished by portraits of the emperors, many of them fine works of art. The most remarkable of the churches is the Dom or Cathedral of St. Bartholomew, in which the German emperors after 1711 were crowned. It was begun in 1238, and completed, except the tower, in the sixteenth century. It was seriously injured by fire in 1867, but has now been completely restored according to the original design. Other buildings deserving of notice are the courts of justice, of modern construction; the new opera-house, one of the finest buildings of the kind anywhere; the Saalhof, now accommodating the conservatory of music, a gloomy-looking building on the site of a palace of Louis le Debonnair, Charlemagne's son, and all modern except the chapel, which is of ancient Gothic; the spacious and handsome new exchange; the large palace of the Prince of Thurn and Taxis; the building for preserving the municipal archives; the town library; the Eschenheim Tower, the only one of the old tower gateways of the city still existing; the synagogue, built in the Oriental style; the mint, post-office, theatre, and the house in which Luther lived. There are monuments to Gutenberg, Goethe, Schiller, and others.

Frankfort is rich in collections connected with literature, science, and art, and in establishments intended to promote them. The chief of these are the Städel Institute and school of art, containing a good picture-gallery and other collections, in a handsome building in Sachsenhausen; the Senckenberg Museum of Natural History; the town library, possessing 150,000 printed volumes, several valuable MSS., and other curiosities. There are also a zoological garden and what is called the Palm Garden, both favourite resorts. Of educational institutions there is no lack, and among them are two conservatories of music. About a mile outside the walls is the new cemetery, at the gate of which is a house where bodies are deposited for a time previous to interment, and watched till decomposition commences. Here every convenience of warm baths and other appliances needful in cases of suspended animation are kept in readiness.

The manufactures of Frankfort are not individually important. Those of woollens and linens, which were once carried on to a great extent, have almost ceased to exist. Those which still maintain their ground are chiefly articles of vertù in bronze and metal gilt, chemical products, chocolate, ironmongery, colours, gold and silver thread, japan and brass ware, sewing-machines, types, playing-cards, snuff and tobacco, straw hats, tapestry, carpets, wax-cloth, and ink for copperplate and lithographic printers. There are extensive breweries. Hardware manufactures, leather manufactures, and cotton spinning are extensively carried on in some of the small towns closely adjoining. The central situation of the town has secured it an extensive trade, and it forms the terminus of a number of railways which since 1888 are run into a handsome central station. It has also communication with the North Sea by way of the Main and the Rhine, and the largest vessels navigating the latter can now reach Frankfort. It has a great trade in wine, silk, wool, and timber, and is an important centre of transit trade. The trade in English wares has greatly fallen off since Frankfort joined the Zollverein. But by far the most important interest of Frankfort is in money and banking. In connection with the trade should be mentioned the two fairs of Frankfort, which, however, are steadily declining.

Frankfort is a very ancient town, and is said to have been originally a Roman station. Charlemagne held a council here in 794, and it has already been mentioned that his son, Louis, built a palace here. A chapel dedicated to St. Elizabeth, built by the same monarch, still exists. In 834 Louis the German made this town the capital of the Frankish Empire, but in 889 the seat of empire was transferred by Arnulf to Regensburg. The independence of the town dates from 1257, when it expelled the imperial governor during the interregnum, and it was made an imperial free city by a decree of the Emperor Louis V. in 1329. Frederick Barbarossa had been elected emperor here in 1152, and in 1356 the right of being the place of election for all future emperors was granted to it by the Golden Bull. In 1555 the privilege of coining money and the free navigation of the Main were conferred upon it by Charles V.; and the town was confirmed in all its rights by the Treaty of Westphalia in 1648. Frankfort suffered severely in the Schmalkald war (1552), the Thirty Years' war (1635), the Seven Years' war (1762), and during the French wars (1792, 1796, 1799, 1800, 1806). Under Napoleon it became the capital, first of a principality, and then, in 1806, of a grand-duchy, with an area of nearly 2000 square miles. His downfall restored its independence; and the Congress of Vienna, in 1815, finally determined its position by giving it precedence among the four free towns of Germany, and making it a member and the capital of the Germanic Confederation. In the same year it received a new constitution, based upon that which it had enjoyed as an imperial free city, but this was considerably modified in 1848. Having joined the enemies of Prussia in 1866, it was occupied by Prussian troops during the war, and by patent of Oct. 18, 1866, incorporated with Prussia. On the 10th of May, 1871, the definitive peace between France and Germany, terminating the Franco-German war, was concluded here. Pop. (1900), 288,989.

FRANKFORT-ON-THE-ODER (*Frankfurt an der Oder*), a town in Prussia, in the province of Brandenburg, on the Oder, 52 miles E.S.E. Berlin. It is built with considerable regularity, four spacious streets traversing it nearly in parallel lines north to south. It is the seat of a superior appeal court, and other courts and public offices. The principal church is the Marien, or Oberkirche,

of the thirteenth century, with good painted glass windows and a very large organ. The manufactures consist of woollen and linen cloths, silks, hosiery, gloves, leather, delft and common earthenware, wax, sugar, and brandy; and the trade, general and transit, is extensive both by land and water, particularly the latter, about 2000 vessels annually passing the town. There are also three important annual fairs, much frequented by dealers from Poland. The university, founded at Frankfort by the elector Joachim in 1506, was transferred to Breslau in 1816. At the extremity of the bridge on the right bank of the river a monument has been erected to Prince Leopold of Brunswick, who perished in endeavouring to rescue a family during an inundation of the Oder. Frankfort possesses a bathing establishment, with chalybeate springs, and vapour and sulphur baths. Frankfort was besieged by the Margrave Thierry of Misnia in 1290, by the Emperor Charles IV. in 1348, when the town supported the pretender Waldemar, and several times during the Thirty Years' war. It was taken by storm by Gustavus Adolphus on the 3d of April, 1631. At Kunersdorf, in the neighbourhood, a great but indecisive battle took place in 1759, between the Prussians, under Frederick the Great, and the Austro-Russian army. In this battle the poet Ewald von Kleist, a native of Frankfort, was fatally wounded. A monument has been erected to him over his grave in Frankfort. Pop. in 1895, 59,161; in 1900, 61,852.

FRANKINCENSE. This name has been given to the oleo-resinous exudations from different species of conifers. American frankincense is got as a soft yellow resinous solid, with a characteristic turpentine odour, from *Finus taeda*. Another kind is exuded by the spruce fir, and forms a soft solid, the colour of which varies from white to violet red. From this Burgundy pitch is prepared by melting in water and straining through a cloth. Burgundy pitch has a whitish yellow colour, and is used in medicine for plasters. Several species of *Icica* and *Croton*, belonging to America, also yield substances to which the name of frankincense is given. The frankincense employed in religious ceremonies (called also *incense* and *olibanum*) is a gum resin obtained from *Boswellia thurifera* (or *serrata*), a tree somewhat resembling the sumach, belonging to the Amyridaceæ, and inhabiting the mountains of India. The leaves are pinnate, and consist of about ten pairs of hairy, serrated, oblong leaflets; the flowers are pale pink. *B. floribunda* also produces frankincense. It comes to us in semi-transparent yellowish tears, or sometimes in masses, of specific gravity 1·22, it possesses a bitter and nauseous taste, and is capable of being pulverized. When chewed it excites the saliva and renders it white, and when burned it exhales a strong aromatic odour, on which account it was much employed in the ancient temples, and still continues to be used in Catholic churches. It is frequently mentioned in the Bible as having been used in the religious ceremonies of the Jews. Formerly it was frequently administered medicinally, but myrrh and other similar articles have now taken its place. That which is brought from Arabia is more highly esteemed than the Indian. Olibanum has been analyzed, and its composition has been shown to be resin, gum analogous to gum-arabic, bassorin, and ethereal oil.

FRANKING LETTERS, a privilege formerly enjoyed by members of both Houses of Parliament, consisting in the right of having all letters sent free which bore the name of any member on the outside. This privilege was claimed by the House of Commons in 1660, when the post-office was first legally established, and although it was not then guaranteed to the members by act of Parliament, it was nevertheless enjoyed by them in virtue of repeated warrants of the postmaster-general until 1763, when the privilege was confirmed to them, and regulated by 4 George III. cap. xxiii. The practice of franking was further regulated by 35 George III. cap. liii. (1795), and was greatly restricted by 7 William IV. and 1 Vict. cap. xxxii., which required all franked letters to be addressed by the person who franked them, and to be posted on the day they were franked or the day after at a post-town within 20 miles of the place where the person franking happened to be then residing. To secure this the person franking was required to add his own name, the name of the post-town, and the day of the month. The privilege was entirely abolished by 3 and 4 Vict. cap. xcvi. (Aug. 10, 1840), the act establishing a uniform penny postage throughout the kingdom.

FRANKLIN, BENJAMIN, a distinguished American philosopher and statesman, born at Boston, January 17, 1706; died at Philadelphia, April 17, 1790. Having been placed with his brother, a printer, to serve an apprenticeship to that trade, he was in some measure able to gratify a passion that he had early acquired for reading; and he devoted his nights to perusing such books as his limited resources enabled him to obtain. Happening to meet with a work which recommended vegetable diet, he determined to abstain from flesh; and we now find the philosophic printer and newspaper carrier purchasing books with the little sums he was enabled to save by the frugality of his diet. From Shaftesbury and Collins he imbibed those sceptical notions which he is known to have held during a part of his life. His brother published a newspaper, which was the second that had as yet appeared in America. Franklin having secretly written some pieces for it, had the satisfaction to find them well received; but, on its coming to the knowledge of his brother, he was severely lectured for his presumption, and treated with great harshness. One of the political articles in the journal having offended the general court of the colony, the publisher was imprisoned, and forbidden to continue it. To elude this prohibition young Franklin was made the nominal editor, and his indentures were ostensibly cancelled. After the release of his brother he took advantage of this act to assert his freedom. Quitting Boston he first sailed to New York and then set out on foot for Philadelphia, where he obtained employment as a compositor. Here he attracted the notice of Sir William Keith, the governor of Pennsylvania, who induced him by his promises to go to England for the purpose of purchasing types to establish himself in business. On arriving in London (1725) he found that the letters which had been delivered him had no reference to him or his affairs; and he was once more in a strange place, without credit or acquaintance, and with little means. While in London, where he got work in a printing-office, he continued to devote his leisure hours to study, and wrote a small pamphlet himself on Liberty and Necessity, Pleasure and Pain. After a residence of eighteen months in London he returned to Philadelphia, in his twenty-first year, in the capacity of clerk to a dry-goods shop; but he soon returned to his trade, and in a short time formed an establishment in connection with a person who supplied the necessary capital. They printed a newspaper, which was managed with much ability, and acquired Franklin much reputation.

It is impossible for us to trace all the steps of his progress to distinction. His industry, frugality, activity, intelligence; his plans for improving the condition of the province, for introducing better systems of education; and his municipal services, made him

an object of attention to the whole community. His advice was asked by the governor and council of Pennsylvania on all important occasions, and he was elected a member of the provincial assembly. In 1742 he invented the Franklin stove, for which he refused a patent, on the ground that such inventions ought to be made at once subservient to the common good of mankind. Being in Boston in 1746 he saw, for the first time, some experiments in electricity, which led him to begin those investigations which resulted in the identification of lightning and electricity, and the invention of the lightning-conductor. As member of the provincial assembly of Pennsylvania he showed himself very active. Pennsylvania was then a proprietary government, and the proprietaries claimed to be exonerated from taxes. In consequence of the disputes to which this claim gave rise, Franklin was sent out (in 1757) to the mother country as the agent of the province. To aid the cause of his constituents he published (in 1759) a considerable work entitled the Historical Review, which was completely successful. His reputation was now such, both at home and abroad, that he was appointed agent of the provinces of Massachusetts, Maryland, and Georgia. Oxford and Edinburgh conferred on him their highest academical degrees, and the Royal Society elected him a fellow. During his residence in England Franklin formed personal connections with the most distinguished men of the country and of the Continent; his correspondence with whom displays a striking union of a cultivated mind with a native and lively imagination. In 1762 he returned to America; but, new difficulties arising between the province and the proprietaries, the assembly determined to petition for the establishment of a regal government, and Franklin was again appointed agent in 1764.

But the American revolution was now commencing, and he appeared in England no longer as a colonial agent, but as the representative of America. He arrived in London in 1764, about thirty-nine years after his first landing in England as a destitute and deluded mechanic. The project of taxing the colonies had been already announced. He carried with him a remonstrance of the provincial assembly of Pennsylvania against it, which he presented to Grenville before the passing of the stamp-act. He opposed the adoption of that measure, and it was chiefly through his instrumentality that it was repealed in 1766, the year after it was passed. On the passing of the revenue acts of 1767 he became still more bold and vehement in his expostulations, and openly predicted in England that the inevitable result of those and the other similar measures of the ministry would be a general resistance by the colonies, and a separation from the mother country. In December, 1774, he presented to the king the petition of the first American Congress; and he attended, behind the bar (Feb. 1, 1775), in the House of Lords, when Chatham proposed his plan of a reconciliation. In the course of the debate that great man characterized him as 'one whom all Europe held in high estimation for his knowledge and wisdom; who was an honour, not to the English nation only, but to human nature.'

Having received an intimation that the ministers were preparing to arrest him as guilty of fomenting a rebellion in the colonies he embarked for America, and was immediately elected member of the Congress. As a member of the committee of safety and of that of foreign correspondence, he performed the most fatiguing services, and exerted all his influence in favour of the Declaration of Independence. In 1776 he was sent to France as commissioner plenipotentiary, to obtain supplies from that court. He was not, at first, publicly received in his official capacity, but he succeeded in gaining the confidence of the Count de Vergennes; and soon after the reception of the news of the surrender of Burgoyne, he had the happiness of concluding with France the first treaty of the new states with a foreign power, Feb. 6, 1778. He was now appointed minister plenipotentiary to the court of France, and was subsequently named one of the commissioners for negotiating the peace with the mother country. At the close of the negotiations (November, 1782) he requested to be recalled, after fifty years spent in the service of his country, but could not obtain permission to return till 1785. During this interval he negotiated two treaties, one with Sweden, and one with Prussia. The general enthusiasm with which he was received in France is well known. His venerable age, his simplicity of manners, his scientific reputation, the ease, gaiety, and richness of his conversation,—all contributed to render him an object of admiration to courtiers, fashionable ladies, and savants. He regularly attended the meeting of the Academy of Sciences, and was appointed one of the committee which investigated Mesmer's so-called animal magnetism. At a meeting of the Academy he met Voltaire, then in Paris on his triumphal visit. The patriarch of letters and the patriarch of liberty met before a crowded hall, and embraced. On his return to his native country, before he was permitted to retire to the bosom of his family, he filled the office of president of Pennsylvania, and served as a delegate in the federal convention, in 1787, and approved the constitution then formed. Various complete editions of his works have been published; one of the most recent being at New York in 10 vols. (1886-87).

FRANKLIN, Sir John, a distinguished Arctic voyager, born at Spilsby in Lincolnshire, in 1786. Having early declared his predilection for the sea, he entered the navy as a midshipman at the age of fourteen, and was present at the battle of Copenhagen in 1801. He afterwards accompanied Captain Flinders on his voyage to the coast of Australia (1801-3). Shortly after his return he was appointed to the *Bellerophon*, and had charge of her signals during the battle of Trafalgar. Two years later he joined the *Bedford*, which was employed successively in the blockade of Flushing, on the coast of Portugal, and on the coast of America. On the last station she took part in the attack on New Orleans in 1814, when Franklin was slightly wounded, and was rewarded for his gallantry by promotion to the rank of lieutenant. On the peace a period of inactivity ensued; but in 1818, when the interest in Arctic discovery, which the war had interrupted, was renewed, and two vessels, the *Dorothea* and *Trent*, were fitted out for a northern expedition, under Captain Buchan, Franklin was appointed to the latter vessel. The *Dorothea* having been unfortunately disabled after reaching a high latitude, both vessels, in accordance with their instructions, returned. In 1819, while Parry was engaged in exploring the north coast of America, Franklin was employed to co-operate for the same object, by undertaking a journey by land, from Hudson's Bay to the mouth of the Coppermine River. Accordingly he set out accompanied by Richardson and Back, and having traced the coast line as far as Cape Turnagain, lat. 68° 30′ N., was compelled to return. This was effected, not without the greatest difficulty and almost unheard-of privations. On his arrival in England in 1822, Franklin was promoted to the rank of captain. Great as his sufferings had been his courage was not abated, and as soon as he heard of another intended expedition he volunteered to take the command of it. His services, as well as those of his former able co-

adjutor Richardson, were accepted, and he set out in 1825 on a second exploration. The expedition sailed from Liverpool on the 16th of February, 1825, but experienced so many detentions that it was found impossible to embark on the Mackenzie till the middle of August. The season being thus too far advanced, it was resolved to pass the winter on the banks of the Great Bear Lake, and in the meanwhile employ as much of the season as yet remained in making such explorations as might be practicable. After passing the winter of 1825–26, the expedition prepared to take advantage of the approaching spring, and, on the 28th of June, began to descend the Mackenzie. On the 4th July, having reached the point where the river pursues its course by several channels, two separate parties were formed, one under Richardson taking the eastern branch, to explore the coast as far eastward as the Coppermine River; while Franklin, taking the western branch, was to proceed from the mouth of the Mackenzie westward, in the hope of being able to double Icy Cape, and meet an expedition which had sailed under Captain Beechey for Kotzebue's Inlet. After surmounting numerous difficulties Franklin succeeded in reaching a point of the coast in lat. 70° 30′ N., and lon. 150° W.; but here the ice became so compact as to give no hope of penetrating it, particularly as the winter season was again approaching, and he therefore had no alternative but to retrace his steps. Shortly after his return home the honour of knighthood was conferred upon him, and he received the degree of D.C.L. from Oxford, but he remained unemployed till 1830, when he was appointed to H.M.S. *Rainbow*. After serving with her in the Mediterranean for three years he was appointed governor of Van Diemen's Land. This situation he held till 1843, and then returned to England. He was now on the borders of sixty, but his longing for active employment was as strong as ever, and another Polar expedition having been resolved upon he gladly accepted the command. It consisted of two vessels, the *Erebus* and *Terror*, which had already performed the voyage of discovery towards the south pole, under Captain Ross, and it sailed on the 19th of May, 1845. On the 26th of July it was seen in Melville Bay, but from that time no direct tidings were received from it. At first no great anxiety was felt. The care with which the expedition had been fitted out, and the tried ability of the commander, made any supposition more probable than that a tragical fate had befallen it, and hypotheses, more or less plausible, accounting for the absence of intelligence, gave ground for hope that all might yet be well. At last, however, when year after year passed away, the anxiety previously felt by the immediate friends of those employed in the expedition extended to the public generally, and it was determined to leave no means untried to rescue the expedition, if rescue was still possible, or at all events to ascertain its fate. The search was commenced in 1848, and carried on simultaneously but unsuccessfully in several different directions. The failure of these first expeditions only stimulated to new endeavours, and between 1850 and 1854 the search was carried on on a still larger scale, but with no better results. At last an expedition, sent out under Captain M'Lintock in 1857, discovered in 1859, at Point Victory, in King William's Land, a document which had been deposited eleven years before, and gave the latest details of the ill-fated expedition. It consisted of one of the printed forms usually supplied to discovery ships, for the purpose of being inclosed in bottles and thrown overboard at sea, and furnished the following information:—On the 28th of May, 1847, when it was dated, the expedition, after wintering at Beechey Island and ascending Wellington Channel to lat. 77° N., had returned by the west side of Cornwallis Island. At this date Sir John Franklin was commanding the expedition, and all were well. A writing on the margin, dated 25th April, 1848, and consequently eleven months later than the former, told a different and very mournful tale. Sir John Franklin had died on the 11th of June, 1847, and the total loss by death to this date had been nine officers and fifteen men. The ships had been deserted on the 22nd April, 1848, having been beset since September, 1846, and the surviving officers and crews, consisting of 105 souls, had proceeded 5 leagues S.S.E. from the place where the ships were abandoned, and landed in lat. 69° 37′ 42″ N., and lon. 98° 41′ W. The Esquimaux reported that all the crews had died; and some bodies were found, and various relics of the unfortunate expedition.

FRANKLINITE. This mineral is found crystallized in the form of the regular octahedron (its primary form), though more generally its crystals are highly modified by various replacements so as to become nearly globular in their shape. Its common mode of occurrence is in granular masses. It is black, brittle, and slightly magnetic. Specific gravity, 5·07. It consists of oxide of iron, 64·5 to 66; oxide of zinc, 21·8, and oxide of manganese, 12·23 to 13·5, and is therefore considered as belonging to the group of minerals, called *spinels*. Franklinite is employed as an ore of iron, though it was at first treated for zinc. According to various accounts it has been found an extremely valuable substance for quickly improving the value of malleable from inferior cast-iron. It is very probable that the zinc in the ore volatilizes in the furnace, and carries away the sulphur and phosphorus, which are the most objectionable ingredients. It occurs very abundantly in New Jersey, accompanying the red oxide of zinc, and is often imbedded in limestone, associated with garnet, &c.

FRANK-PLEDGE (Saxon, *Freoborh;* Latin, *Franci plegium*), literally pledge or surety for a freeman. According to some the original word is not *freoborh*, but *frithborh*, that is, a pledge of peace, namely, a pledge to keep the king's peace; and the Latin *franci plegium* and the English *frank-pledge* have arisen out of a confusion of the second of the two Saxon words mentioned with the first. This is an institution the origin of which has been ascribed by some of the early English chroniclers to Alfred the Great; but Hallam attributes this ascription merely to the tendency of the generations succeeding the time of Alfred to ascribe to that great ruler every institution of obscure origin, and refuses this honour to Alfred on the ground that there is no contemporary evidence of his claim to it. The institution appears indeed to have been in existence in some form or other before the time of Alfred, although it is not till the time of Canute that a general law is found enforcing frank-pledge in its ultimate form. The nature of the institution was this, that every free-born man on reaching the age of fourteen should appear before the sheriff of the county and connect himself, or allow himself to be connected, with some tithing or association of ten men, each of whom was responsible for the other, so that if any one of them committed any fault the other nine were required, within thirty-one days, to bring him to justice. If this were not done the head of the tithing had an opportunity of clearing himself both of the crime committed and of the flight of the malefactor by bringing to his defence the headman of each of the three tithings nearest to his own, and two of the best men in each, his own included. If he were unable to clear himself in this way, then he was bound to restore the damage done out of the property of the malefactor, and if this did not suffice, out of his

own and that of the tithing. If at any subsequent time they were able to recover him, they were bound to bring him to justice, or tell the justice where he was. The institution was thus one by which all the members of a tithing were constantly required to be bail for each. Each association of ten men was called by the English generally a *freoborh* or *frithborh*, and by the people of Yorkshire 'ten men's tale.'

FRANKS. See FRANCE—History.

FRANZENSBAD, or EGERBRUNNEN, a celebrated watering-place in Bohemia, about 3 miles north of Eger, with which it is connected by a fine avenue. The mineral springs here were known in the sixteenth century, and even at that time the waters were made up in bottles to be sent to a distance. Egerbrunnen was selected as a watering-place in 1793 by the Emperor Francis II., from whom it received its present name. The bathing establishment consists of an irregular building, erected over the springs, with a long colonnade extending to the Kurhaus, where the visitors assemble, and balls and concerts are given. The springs, twelve in number, are alkaline, saline, chalybeate, and are very efficacious in cases of anæmia, dyspepsia, catarrh of the bowels, uterine disorders, &c. The mud baths of Franzensbad are much used by those suffering from gout, rheumatism, some skin diseases, &c. The number of bottles made up for despatch to a distance increases every year, and now exceeds 400,000. Pop. (1900), 2330.

FRASCATI, one of the most charming spots of Italy, on the site of the ancient Tusculum, 11 miles south-east from Rome. Frascati is much resorted to by the Romans in the summer season—*tempo di villeggiatura*, as the Italians call it. Situated on the declivity of a hill, it affords the most enchanting views of the *Campagna di Roma*, of the *Alma città* herself, and of the sea in the distance. Among the villas the Villa Aldobrandini, called also Belvedere, from its beautiful views, is remarkable; it now belongs to the Borghese family. The next in importance are the villas Mondragone, Taverna, and Ruffinella. Fountains, cascades, ruins, bas-reliefs, fresco paintings, and various antiquities, are to be found here. Of Tusculum, a town of Latium, built long before Rome existed, according to tradition by Telegonus the son of Ulysses, numerous interesting remains are to be seen, including an amphitheatre, some ancient pavement formed of polygonal masses of lava, a theatre, and numerous remains of baths and fountains. In the neighbourhood are the ruins of Cicero's villa, called Tusculanum, which took its name from the town. Tusculum was destroyed by the Romans, with the permission of the German emperor, in 1191. Pop. 7500.

FRASER, SIMON. See LOVAT.

FRASERBURGH, a flourishing seaport in Scotland, Aberdeen, on the south side of Kinnaird's Head, 22 miles east of Banff. It is substantially built, nearly in the form of a square, and has a handsome town-hall, a remarkably fine market-cross, building-yards, and two good harbours which have recently (1875–97) been deepened, extended, and otherwise improved. Fraserburgh is the chief seat of the Scotch herring-fishery, sending out some 800 or 900 boats during the season, and exporting great quantities of herring. Pop. in 1891, 7466; in 1901, 9105.

FRASER RIVER, the principal river in British Columbia, rising in the Rocky Mountains, in lat. 53° 42′ N.; lon. 119° W. It flows north-west for about 270 miles, then turns south, and after a total course of over 700 miles falls into the Gulf of Georgia, in lat. 49° N. Gold is found both on the Fraser and its affluents. Its principal affluents are the Thomson, Quesnelle, and Stuart rivers. In the lower valley of the river there is excellent farming land, and the export of canned salmon is now extensive. It is navigable to Yale, the other important towns being New Westminster, Hope, and Lytton.

FRATERNITIES, religious societies for pious practices and benevolent objects. They were often formed during the middle ages, from a desire of imitating the holy orders. From the twelfth to the fifteenth century nothing was considered more meritorious than to form and belong to such orders. The laity, who did not wish to pronounce the monastic vows, entered into associations in order to gain some of the advantages of the religious even in their worldly life. These societies were at first formed without any ecclesiastical interference, and on this account many of them, which did not obtain or did not seek the acknowledgment of the church, had the appearance of separatists, which subjected them to the charge of heresy; as, for example, the Beguines and Beghards, the Brothers and Sisters of the Free Spirit, the Apostolic Brethren, the Flagellants, and Brothers of the Cross. (See the article FRANCISCANS, whose third order presented similar appearances.) The church tolerated them for a longer or shorter time, but finally persecuted and suppressed them as heretics. The pious fraternities which were formed under the direction of the church, or were acknowledged by it, were either required by their rules to afford assistance to travellers, to the unfortunate, the distressed, the sick, and the deserted, on account of the inefficiency of the police, and the want of institutions for the poor, or to perform certain acts of penitence and devotion. Of this description were the Fratres Pontifices, a brotherhood that originated in Tuscany in the twelfth century, where they maintained establishments on the banks of the Arno, to enable travellers to cross the river, and to succour them in case of distress. A similar society was afterwards formed in France, where they built bridges and hospitals, maintained ferries, kept the roads in repair, and provided for the security of the highways. A bridge of eighteen arches over the Rhône at Avignon, built by St. Bénézet in 1177, and another of twenty-two arches over the same river at Pont St. Esprit, built between 1265 and 1309, were amongst their greatest achievements in bridge-building. They gradually amassed great wealth by alms and gifts. In 1519 they were secularized on account of the abuses that had crept into the order. A separate congregation of this order, which had its chief seat at the Hospital of St. Jacques du Haut Pas, had previously been suppressed by a bull of Pope Pius II. in 1459.

Similar to these were the Knights and Companions of the Santa Hermandad in Spain; the Familiars and Cross-bearers in the service of the Spanish Inquisition; the Calender Brothers in Germany; the Alexians in Germany, Poland, and the Netherlands, &c. The professed object of the Alexians was to visit the sick and imprisoned; to collect alms for distribution; to console criminals, and accompany them to the place of execution; to bury the dead, and to cause masses to be said for those who had been executed, or for persons found dead. They derived their name from Alexius, their patron saint, and were at first principally composed of persons from the lower classes of the people in the Netherlands. They were afterwards increased by the addition of the female branch, the Black Sisters. Although lay brothers they had houses, and formed their order into two provinces under an ecclesiastical government. They still exist, in the societies for burying dead bodies, in Antwerp, Utrecht, and Cologne. The Brothers of Death, of the order of St. Paul, were dressed in black, like the Alexians, and were distinguished by

a death's head on their scapulary. They were suppressed by Pope Urban VIII.

There were also Gray Penitents (an old fraternity of an order existing as early as 1264 in Rome, and introduced into France under Henry III.), the black fraternities of Mercy and of Death; the Red, the Blue, the Green, and the Violet Penitents, so called from the colour of their cowl; the divisions of each were known by the colours of the girdle or mantle. The fraternity of the Holy Trinity was founded at Rome in 1548 by Philip de' Neri for the relief of pilgrims and the cured dismissed from the hospitals. The Brothers of the Christian Schools are a fraternity founded near the end of the seventeenth century, the statutes of which were approved by Benedict XIII. Their labours have been of great service to neglected young people in France, though their work is not confined to France, but extends over a large part of the world, including Belgium, North and South America, and England. They take religious vows, wear a suit of clerical dress, and always work in pairs. In Ireland there is a body of Christian Brothers modelled on the French one, the first of its schools having been opened at Waterford in 1804. Their schools have spread over Ireland, and their system of education has received the approval of various Royal Commissions.

The Brothers of Common Life, founded at Deventer in Holland by the celebrated theologian Gerald Groot towards the end of the fourteenth century, and formally approved by Gregory XI. in 1376, were a fraternity which performed great services to learning, especially theological learning. From Holland they spread rapidly over Germany, and increased so greatly in numbers that 500 houses belonged to the order in 1460. The Roman Catholic Church is indebted to it for a text of the Latin version of the Bible by St. Jerome, most carefully prepared by a collation of the most ancient MSS. This text was consulted as an authority by the editors of the Bible prepared at the command of Sixtus V. The same order prepared some texts of the Christian fathers.

The Brothers of Charity are another fraternity whose hospitals are found in the principal cities of Catholic christendom. It was founded by St. John de Dieu in Spain in 1540. Much better known in Britain are the Sisters of Charity (called also Gray Sisters, Daughters of Charity, Sisters of St. Vincent de Paul), a Roman Catholic order founded in 1634 at Paris by St. Vincent de Paul for the purpose of nursing the sick in hospitals. The sisters take vows of poverty, chastity, and obedience, besides a vow binding themselves to serve the sick. Besides conducting hospitals and nursing, they sometimes undertake the management of poor schools. They attend the sick of every condition, nation, and religion. There is also a body of Irish Sisters of Charity, separate from the one just mentioned.

FRATICELLI, the Italian diminutive of *frate*, brother or monk, the name given about the end of the thirteenth and during the fourteenth century, and even later, to wandering mendicants of different kinds, but especially to certain Franciscans, who pretended to practise the rules of their order in their full rigour, and refused to submit to Papal decisions explaining the rule of the order, and therefore separated themselves from the rest of the body to which they belonged, and dissolved their connection with the church. They were condemned in 1317 by a bull of John XXII. They soon sunk into contempt, as they seemed to consider Christian virtue as consisting altogether in squalid poverty, and by the beginning of the sixteenth century they had quite disappeared. See FRANCISCANS.

FRAUD. All frauds or attempts to defraud which cannot be guarded against by common prudence, are indictable at common law, and punishable arbitrarily according to the heinousness of the offence. In cases where common prudence might have guarded a man, he is left to his civil remedy, the suing for damages. The deceiving by false weights or measures, or false tokens, is a criminal offence.

The validity of a contract is destroyed when there is any error in the essentials of the contract through the fraud of any of the contracting parties. In this case the party upon whom the fraud has been practised has not really given his consent to the provisions contained in the contract, inasmuch as he has been fraudulently kept in ignorance as to what these provisions were, and therefore the contract is altogether void, and cannot even be enforced by one who was no party to the fraud, and has in any way acquired the right of the fraudulent party to his share of the contract. When the error is not in the essentials the contract may nevertheless be invalidated if fraud has been used by either of the parties to bring it about, and in such a case the contract may be set aside in Scotland by the Court of Session, but only when fraud is pleaded by the defrauded party against the fraudulent party—not against any *bonâ fide* onerous assignees of the latter. Fraud may be by false representation, concealment of material circumstances that ought to be revealed, underhand dealing, and by taking advantage of imbecility or intoxication, especially when the fraudulent party has made the other party intoxicated with intent to obtain the consent of the latter to a contract to which he knows he would not have given his consent when sober. In commercial dealings a certain latitude is allowed to misrepresentation when it amounts to no more than the ordinary artifices to which traders resort in order to find purchasers for their goods, and against which it is presumed that every purchaser ought to be on his guard. Such misrepresentation only amounts to what lawyers term *dolus bonus*, and is not sufficient to constitute fraud or *dolus malus* in the legal sense of the term. In regard to concealment again, no fraud is considered to have been practised unless it can be shown that one party to a contract has concealed what he was bound to discover to the other, so that where a merchant having received information which is of service to him in conducting a negotiation with any other party who has not received the same information, and concludes a contract with the latter without discovering this information, he is not held to be guilty of a fraud. But where the one party to a contract relies solely on the other for information as to the material circumstances on which a contract is based, as in the case of a person effecting an insurance in an insurance office, then any concealment invalidates the contract. A contract may also be voided when no fraud has been practised by either of the parties against the other, but where fraud is intended against another person not a party to the contract, as in the case of a marriage-brocage contract, in which one party contracts with another to effect a particular marriage by influence brought to bear on one of the parties. The intoxication of one of the parties to a contract is not of itself sufficient to render it void unless the party was so thoroughly intoxicated as not to be aware of what he was doing, but when the one party has been designedly intoxicated through the influence of the other, the latter is always held to be guilty of fraud, and the contract may be set aside. In cases of contracts between persons who stand in such a relation to one another as is likely to produce a peculiar degree of mutual confidence between them, such as landlord and tenant, partners in a business, principal and surety, and the like, if either of them is charged with fraud it

will be necessary for him, in order to relieve himself from the charge, to prove that he has not taken an undue advantage of the confidence which his relationship to the other contracting party was calculated to inspire in him.

FRAUENLOB, HENRY, a name of honour bestowed upon a minstrel (*meistersänger*), who lived at the close of the thirteenth and the beginning of the fourteenth century, of whose life, however, we know nothing, except that he practised his art at Mainz, and died in that city in 1317. According to the opinion of some writers he was a doctor of divinity and canon at Mainz. His real name seems to have been Heinrich von Meissen, by which he is sometimes mentioned. The principal theme of his songs was the virtues of the fair sex. For this reason he was so highly esteemed by the ladies of his time that they are said to have carried his body with their own hands to the grave, which they bathed with their tears, and around which they poured so much wine as to inundate the whole floor of the church. The most complete edition of his poems is that of Ettmüller (Quedlinburg, 1843).

FRAUNHOFER, JOSEPH VON, was born at Straubing in Bavaria, March 6, 1787; died at Munich, June 7, 1826. In his eleventh year he lost his parents, and in 1799 he was placed with a looking-glass maker and glass-grinder at Munich. After various vicissitudes in his life he received an appointment as optician in the mathematical and mechanical institute of Reichenbach at Benedictbeurn, and in 1809 the mechanical part of the optical institute was chiefly under his direction. Ultimately he became one of the members of the firm under which the business was conducted. One of the most difficult operations of practical optics was to polish the spherical surfaces of large object-glasses accurately. Fraunhofer invented a machine which obviated this difficulty, and rendered the surface more accurate than it was left by the grinding. He invented also other grinding and polishing machines, and introduced many improvements into the manufacture of the different kinds of glass used for optical instruments, and which he found to be always injured by flaws and irregularities of various sorts. In 1811 he constructed a new kind of furnace, and on the second occasion when he melted a large quantity found that he could produce flint-glass, which, taken from the bottom of a vessel containing 2 cwt. of glass, had the same refractive power as glass taken from the surface. He did not again succeed so well for some time; yet he continued to study the causes of his failure, always melting at once 4 cwt. He found that the English crown-glass and the German table-glass both contained defects which occasion irregular refraction. In the thicker and larger glasses there would be more of such defects, so that in larger telescopes this kind of glass would not be fit for object-glasses. Fraunhofer therefore made his own crown-glass. The cause which had hitherto prevented the accurate determination of the power of a given medium to refract the rays of light and separate the different colours which they contain was chiefly the circumstance that the colours of the spectrum have no precise limits, and that the transition from one colour into another is gradual and not immediate; hence the angle of refraction cannot in the case of large spectra be measured within 10′ or 15′. To obviate this difficulty Fraunhofer made a series of experiments for the purpose of producing homogeneous light artificially, and as he was unable to effect his object in a direct way, he invented an apparatus which enabled him to attain it by means of lamps and prisms. In the course of these experiments he discovered that bright fixed line which appears in the orange colour of the spectrum when it is produced by the light of fire. This line enabled him afterwards to determine the absolute power of refraction in different substances. Experiments to ascertain whether the solar spectrum contains the same bright line in the orange as that produced by the light of fire led him to the discovery of the innumerable dark fixed lines in the solar spectrum, consisting of perfectly homogeneous colours. The importance of this discovery can scarcely be overestimated. It led to the invention and use of the spectroscope, to the science of spectroscopy, and to all our present knowledge of solar and stellar chemistry. Information on these subjects will be found under SPECTRUM, SPECTROSCOPE, &c. Fraunhofer described his experiments relating to these discoveries in vol. v. of the Memoirs of the Royal Bavarian Academy, and in vol. lv. of Gilbert's Annalen der Physik. In 1817 he was chosen a member of the Academy of Sciences at Munich. In 1819 the optic institution, which had become so famous under his direction, was transferred from Benedictbeurn to Munich, where it continued to enjoy its former celebrity. Besides those above-mentioned Fraunhofer made a variety of other important discoveries, and invented or improved several extremely useful instruments, such as the heliometer, the ring-micrometer, &c. He likewise constructed a grand parallactic refractor for the University of Dorpat. It may be mentioned also that he made with his own hands all the instruments with which he performed his experiments.

FRAUSTADT, or WSCHOWA, a town in Prussia, in the government of Posen, and 15 miles north-east of Glogau. It stands in a sandy plain, is the seat of a law court, and several public offices; consists of the old and new town, and a suburb, and has manufactures of woollen and linen cloth, chicory factories, breweries, distilleries; a trade in corn, wool, and cattle, and four annual fairs. In the neighbourhood are numerous wind-mills. The Saxons and Russians under Schulenburg were entirely defeated here by the Swedish under Renskiold in 1706. Pop. (1900), 7462.

FRAXIN and ÆSCULIN, two fluorescent bodies contained in horse-chestnut bark. Fraxin, however, is also contained in the common ash, from which it was first extracted in 1856. It was especially examined by Stokes, who extracted from horse-chestnut bark a substance which he called paviin, and this was afterwards ascertained to be identical with fraxin.

From an infusion of ash-bark fraxin is got by precipitating with acetate of lead, filtering, adding basic acetate of lead to the filtrate, decomposing the lead precipitate, and crystallizing the solution. From horse-chestnut bark the extraction of the fraxin is complicated by the presence of the æsculin and of tannic acid. Several methods for obtaining these bodies have been found successful, based upon their different solubilities in ether and alcohol, and by their different behaviour with lead acetate. Fraxin, however prepared, forms colourless prisms or yellowish four-sided shining needles, disposed in tufts. The formula now assigned to it is $C_{16}H_{18}O_{10}$. It has a feeble bitter taste, but no odour. It is soluble in hot water and hot alcohol. The solutions are remarkable for their blue or blue-green fluorescence, a property which is intensified by the addition of a little ammonia, but removed by acids. When heated to 608° Fahr. it fuses, loses water, and changes to a red fluid that solidifies without crystallizing. At a higher temperature it is decomposed, with formation of a crystalline sublimate. When boiled with dilute acids it decomposes into sugar and a crystalline body called *fraxetin*, which dissolves in hot, but is practically insoluble in cold water, and has a faint astringent taste. Neither fraxin nor fraxetin has been employed medicinally.

Æsculin, the other fluorescent constituent of horse-chestnut bark, forms a brilliant, white, finely crystalline powder, with no odour, but a faint bitter taste, and acid reaction. It is sparingly soluble in cold, more readily in boiling water, difficultly soluble in alcohol, insoluble in ether. Its aqueous solution is colourless by transmitted, but shows bright blue fluorescence by reflected light. This is exhibited even by a solution of one part of æsculin in 1,500,000 parts of water; it is heightened by bases, removed, but not destroyed by acids. At 320° æsculin melts; at a higher temperature it decomposes. Boiled with dilute hydrochloric or sulphuric acid it yields sugar and *æsculetin*, a substance which forms pearly crystalline scales like benzoic acid, and appears to be a weak acid. Æsculin has been employed in medicine for similar purposes to those of quinine, and seems to be deserving of more attention on this score than it has yet received.

FRAY BENTOS, a small town in the republic of Uruguay, on the left bank of the river Uruguay, about 170 miles north-west of Monte Video. It owes its existence and prosperity to the establishment in 1864 of the immense slaughter-houses and other establishments connected with the extract-of-meat trade. Besides this extract, jerked beef, hides, tallow, wool, &c., are exported. Pop. about 5000.

FRECKLES, the well-known brownish-yellow spots of a circular form on the human skin. They are due to excess of pigmentary matter in the cells of the deepest layer of the epidermis or cuticle, immediately above the true skin, and only appear to any appreciable extent on those surfaces exposed to the action of light, as the neck, face, hands, and arms. On these parts they are sometimes congregated in thick clusters which give to the features an unsightly appearance. Sometimes freckles are hereditary, appearing soon after birth, and continuing throughout life, or subsiding or vanishing altogether at the age of puberty. Sometimes, however, the disfigurement will disappear without any appreciable cause at other periods. This affection is most common as well as most persistent in persons of fair complexion and hair, and especially so in those with red hair. There can be no doubt that exposure to the sun increases the disfigurement, so that it would be desirable for those afflicted by freckles to shade the features as much as possible from direct sunlight. The skin may also be excited to more healthy action by some slightly stimulating lotion, and the freckles may disappear, at least for a time.

FREDEGONDE, the wife of Chilperic, a Frankish king of Neustria, was born in 543. The station of her parents is unknown. While in the service of the first and second wives of Chilperic her beauty captivated the king and she became his mistress. In order to arrive at the throne Fredegonde got Andowena, the first wife of the king, removed by artifice, and the second (Galswintha) by assassination (568). This led to a war between Chilperic and his brother Sigebert, king of Austrasia; Brunehilde, wife of Sigebert and sister of the murdered queen, urging her husband to vengeance. Chilperic was defeated by his brother, besieged in Tournai, and seemed to be lost, when Fredegonde, who had now become his wife, found means to have Sigebert assassinated. She then took advantage of the confusion which this event produced in the camp of the enemy to attack and defeat them, and advanced to Paris, where she took Brunehilde and her daughters prisoners. Chilperic, however, afterwards sent Brunehilde back to Metz, where her son Childebert was proclaimed king in 575. The sons of her husband by his first marriage now fell victims to the ambition of Fredegonde, and the assassination of Chilperic himself is said to have taken place at her instigation that she might have the opportunity of gratifying another passion. Her sole object now was to protect the interests of her only surviving son Clotaire, and to secure to him the Kingdom of Neustria. With this object she placed him under the guardianship of Gontran, brother of Chilperic, and king of Burgundy and Orleans. She herself was obliged by Gontran to retire to Rueil in the neighbourhood of Reims; but on the death of the latter in 593, when his successor Childebert attempted to seize the dominions of her son, she reappears on the scene directing the war which then broke out. At Droissy near Soissons Childebert was completely defeated, and when Fredegonde died four years later (597) she was able to leave the kingdom in a flourishing condition to her son. See BRUNEHILDE.

FREDERICIA, a seaport town in Denmark in North Jutland, 14 miles south-east of Veile, on a tongue at the north entrance of the Little Belt. It has fortifications of some strength, but latterly neglected. It has an active traffic by steam-ferry with Strib, on the island of Funen; and a well-frequented harbour, at which coals, manufactured goods, colonial wares, &c., are imported, and agricultural produce exported. At its custom-house all ships passing through the Little Belt used to pay toll. The town was founded by Frederick III. in 1650. In 1657 it was taken by the Swedes under Wrangel, after which its fortifications were razed to the ground. They were not restored till 1709–10. In 1849 the army of Schleswig-Holstein was defeated here by the Danes, and in 1864 the Danes were compelled to evacuate it before the superior forces of the Austro-Prussians. Pop. 1890, 10,044; (1901), 12,714.

FREDERICK, a town in the United States, in Maryland, 44 miles north-west of Washington. It has wide streets, a handsome courthouse, a jail, and county offices, several churches, an asylum for the deaf and dumb, academies, schools, paper and woollen factories, roperies, a brewery, pottery, several tanneries, and printing-offices. It is connected by railway with the great cities in its neighbourhood, is surrounded by a fertile country, and has an extensive trade, chiefly in live stock, grain, flour, tobacco, wool, &c. Pop. (1890), 8193; (1900), 9296.

FREDERICK, the name of many distinguished monarchs, particularly of Germany. It is of German origin, and the form of the name in the language from which it is taken is Friedrich, compounded of *Friede*, peace, and *reich*, rich, and meaning peaceful.

FREDERICK I., BARBAROSSA (or, as the Germans call him, ROTHBART, both surnames meaning 'Red-beard'), son of Frederick, duke of Suabia, whom he succeeded in the dukedom in 1147, was born 1121, and received the imperial crown in 1152 on the death of his uncle the Emperor Conrad III. He was the second German emperor of the house of Hohenstaufen, and one of the ablest and most intelligent of the sovereigns of Germany. His principal efforts were directed to the extension and confirmation of his power in Italy. He undertook six campaigns to chastise the rebellious cities of Lombardy, which had become rich and powerful through their commerce and manufactures. The immediate cause of his first expedition into Italy was a complaint from the town of Lodi that it had been brought into subjection to Milan, even then a powerful city, and known to have leanings to the pope, and to be desirous of freeing itself from the supremacy of the emperor. Frederick sent a mandate requiring the city to give up its claims upon Lodi; but the consuls tore up the mandate, and the ambassador of the emperor escaped with difficulty from the rage of the people. The city was speedily humbled, however, when in 1154 Frederick

crossed the Alps with a large army. It at once submitted to the punishment which Frederick inflicted upon it for its recusancy, while the city of Tortona, which resisted, was burned to the ground. Frederick quickly compelled the submission of all the cities of Northern Italy, and then got himself crowned at Pavia with the iron crown of Lombardy (April, 1155), and afterwards at Rome by Pope Adrian IV. with the imperial crown (June, 1155). He then returned to Germany, where he waged successful war with Boleslas, king of Poland. Soon after his return, however, the Lombard cities had risen in revolt, and accordingly Frederick had in 1158 to lead a second expedition into Italy. On this occasion, after subduing Brescia and Milan, he summoned an imperial diet at Roncaglia, at which all the cities and imperial vassals of Italy were represented. Here he caused four of the leading jurists of the University of Bologna to prepare a document which should determine for ever the relations between the empire on the one hand and the cities and imperial vassals of Italy on the other hand. The rights assigned to the empire by these jurists were so great that many of the cities refused to acknowledge them, and Milan especially prepared for resistance. Meantime Pope Adrian IV. died (1159), and in electing a successor the cardinals were divided, one section choosing Victor IV. and another Alexander III. Frederick supported Victor, and Alexander was compelled to flee from Italy and take refuge in France. Frederick had by this time collected another large army in Germany, and in the spring of 1161 crossed the Alps once more and laid siege to Milan. In 1162 the Milanese were starved into surrender, whereupon Frederick razed their city to the ground, and compelled the inhabitants to settle in four different parts of their territory. By this conquest Frederick seemed completely to have attained his end. Northern Italy was reduced to entire subjection, and placed under an imperial governor. But soon after the Italian cities, encouraged by Alexander III., who was still residing in France, formed a league and rose once more in revolt. In 1166 Frederick once more marched into Italy, where he at first carried everything before him, and was even able to set up in Rome the Anti-pope Paschalis III., whom he supported after the death of Victor IV. His successes were put an end to, however, by a terrible pestilence, regarded by his enemies as the judgment of God, which carried off a large part of his army, and compelled him hastily to return to Germany. Scarcely had he settled the most pressing difficulties here when he undertook in 1174 a fifth expedition into Italy; but being deserted at the most critical moment by Henry the Lion, the head of the Guelfs, he was totally defeated in the battle of Legnano on the 29th of May, 1176, in consequence of which nearly all that he had won in Italy was again lost, and he was compelled to acknowledge Alexander III. as the true pope. From this time Italy remained at peace during his reign, and in 1183 he concluded the Peace of Constance with the towns of Lombardy, by which he granted to them the right of self-government and of concluding alliances, while they acknowledged the supremacy of the emperor and his right to impose certain taxes. In Germany, meanwhile, he had broken the power of the Guelfs by depriving Henry the Lion of the greater part of his territories in punishment for his defection before the battle of Legnano. About the same time he raised Regensburg to the rank of an imperial city, as he had previously done Lübeck and Hamburg. Frederick visited Italy yet again before his death; but on this sixth and last occasion (1184) he came without an army. Alexander III. had died (1181), and been succeeded by Urban II., and his present visit was made with the double purpose of having his son Henry crowned as his successor by the new pope, and of bringing about a marriage between his son and Constance, the only daughter and heiress of Roger the Norman king of Apulia and Sicily. In this he was only partially successful. The pope, who disliked the proposed marriage, refused to crown his son; but the marriage was nevertheless solemnized with great ceremony in 1186. News having been received that Saladin had retaken Jerusalem from the Christians, and the pope having preached a new crusade, Frederick, with an army of 150,000 men and several thousand volunteers, set out for Palestine. After leading his army with success into Syria he was drowned in the Kalykadnus (new Selef), June 10, 1190. (See CRUSADES.) Frederick was brave, liberal, and equally firm in good fortune and in reverses; and these qualities atone in some measure for the pride and arrogance which were the principal motives of his actions. He possessed a remarkable memory, and for his age unusual knowledge. He esteemed men of letters, particularly historians, from whose works he drew the exalted idea of an emperor which he endeavoured to realize throughout his reign. He was of a noble and majestic appearance, and notwithstanding his quarrels with the popes, a more faithful adherent to religion than those who used its name to obtain their own purposes.

FREDERICK II., HOHENSTAUFEN, grandson of the preceding, born at Jesi, in the marquisate of Ancona, Dec. 26, 1194, was son of the Emperor Henry VI. and of the Norman Princess Constance, heiress of the Two Sicilies. Henry died, suddenly, in September, 1197, and his widow, Constance, followed him to the grave in 1198. Both in Germany and in Sicily, the death of the Emperor created many difficulties. In Germany, there was a disputed succession between Philip of Suabia, the uncle of the infant Frederick, and Otto of Brunswick, the representative of the House of Welf. (See GERMANY.) The succession of Frederick himself as German king, which had been acknowledged by the princes in 1196, was ignored by both sides. The support of Pope Innocent III., however, in 1212 secured the election of the young Frederick, and in spite of the rivalry of Otto IV. he was crowned at Aachen (Aix-la-Chapelle) in 1215. As the price of the crown, he promised Innocent III. to go in crusade and also to separate the kingdom of Sicily from the imperial crown. This involved an abandonment of the Hohenstaufen policy, and Frederick's refusal to implement his contract is the explanation of his long struggle with the popes. Frederick's aim was to make himself master of all Italy, subdue Lombardy, and reduce the spiritual monarch in Rome to the dignity of the first bishop in Christendom. The Papacy, on the other hand, had developed a scheme of welding the Papal possessions in Italy into a strong Papal State, and Innocent III. and his successors made it the main end of their policy to prevent the incorporation of Sicily into the empire, a step which would have frustrated the Papal design. Frederick had married Constance of Aragon, and in 1220 he caused his eldest son, Henry, to be chosen King of the Romans, appeasing the new pope, Honorius III. (chosen in 1216), who was offended at this measure, by specious assurances. He then went to Rome, received the imperial crown from the pope, and returned as emperor to his hereditary dominions. It was not till 1225 that he brought Sicily into complete subjection. The Norman monarchs had been absolute in Sicily, and Frederick adopted the rôle of a benevolent despot. With the help of his great chancellor, Pierre de la Vigne, he devised a great administrative system, every department of which

was directly dependent on the crown, and which resulted in the accumulation of great wealth, although not till a late stage of his career can Frederick's Sicilian government be justly described as oppressive. He encouraged art, literature, and learning, founding, in 1224, a university at Naples, and reviving the famous medical school at Salerno. Meanwhile Frederick had failed to fulfil his promise of going upon a crusade. The Latin kingdoms in the Holy Land had lost such vitality as they had ever possessed, and in 1221 Damietta fell. Honorius III. threatened to excommunicate the emperor, but Frederick still delayed, and the pope's suspicions were further aroused by Frederick's patronage of the infidel in Sicily. In 1225 Frederick married Iolande de Brienne, the heiress of the kingdom of Jerusalem, but, instead of leaving for the East, he directed his attention to the increase of the imperial power in Italy. Honorius III. died in March, 1227, and his successor, Gregory IX., forced Frederick to start in the following September. But in three weeks the emperor returned, being prevented from carrying out his purpose by an epidemic attacking his army; and when he did reach the Holy Land he was able to effect nothing permanent, although he had crowned himself in Jerusalem as King of Judea. (See CRUSADES.) The only result of this crusade was to bring down upon himself the anger of Pope Gregory IX., first for his delay in setting out, and then for setting out before he had been released from the bull of excommunication which Gregory had issued against him. On his return to Italy, in 1229, he found his dominions in Apulia laid waste by the pope; but he soon recovered them, and in July, 1230, he made the Peace of San Germano with the pope, who granted him absolution for the past, and release from excommunication, in September of the same year. He now made preparations for an expedition against the Lombard cities, which had disowned all allegiance to him, and refused to recognize his son Henry as king of the Romans. While engaged in these preparations he learned that Henry himself had been induced to rebel against his father, and had been promised the support of the Lombards on condition of granting to them all their demands. The followers of Henry were already numerous, even in Germany, when he was surprised by his father, and the astonished youth threw himself at his feet, imploring mercy (1235). He was condemned to perpetual imprisonment, and Frederick's second son Conrad was in 1237 elected king of the Romans in his stead. In 1236 Frederick collected a considerable army at Augsburg, in order to continue the struggle with the Lombards. The alliance of Ezzelino da Romano, ruler of Verona, and the Ghibeline cities of Upper Italy (that is, those favouring the empire), doubled his small army. A victory at Corte Nuova, on the Oglio (26th and 27th Nov., 1237), broke the power of the Lombards. All the Guelf cities surrendered at discretion except Milan, Bologna, Piacenza, Brescia, and even these were ready to pay any money indemnity, or suffer any loss of possessions, provided Frederick would promise them pardon for their rebellion. Frederick, however, would hear of nothing but unconditional surrender, and thus these cities were driven by despair to join in continuing the war. Gregory, who had long looked with jealousy on the successes of Frederick, and who was irritated by the latter investing his son Enzio with the island of Sardinia, which had just been wrested from the Saracens, and which the pope laid claim to in the name of the church, excommunicated Frederick anew on Palm Sunday, 1239. The emperor nevertheless continued the war, but he suffered much by the secret treachery of Ezzelino. To bring the war to a complete termination he marched suddenly against the pope himself (1240), penetrated through Spoleto into the Papal dominions, captured Ravenna, and made the pope tremble in his capital. When Gregory IX., now almost a hundred years old, died, as it were, in sight of the imperial army then besieging Rome (1241), the position of Frederick appeared to improve. After the short reign of Celestine IV. and an interregnum of two years, during which the States of the Church were occupied by the imperial troops, Cardinal Sinibald Fieschi, a Genoese, was elected pope, under the name of Innocent IV. Innocent soon showed that he meant to follow in the same path as Gregory. After some abortive negotiations for peace he secretly left the Papal dominions, and summoned a council at Lyons (1245). Without paying any attention to the defence made by Frederick the pope here renewed in the most rigorous form the sentence of excommunication against the emperor, pronouncing him a blasphemer of God, a secret Mohammedan, and an enemy of the church, declared him to be deprived of his dignities and his crowns, released his subjects from their oath of allegiance, and threatened all his adherents with the curse of the church. The contest was thus renewed in all parts of Frederick's dominions. In Germany the Papal party succeeded in bringing about, in 1246, the election of a rival emperor in the person of Heinrich Raspe, landgrave of Thüringen; and when the latter was defeated at Ulm by Frederick's son Conrad, and died in the Wartburg, the young Count William of Holland was induced to accept the royal dignity. The imperial cities, however, and most of the secular princes, remained faithful to Conrad. Frederick himself was engaged in Italy, where he used against the supporters of the Papacy the doctrine of apostolic poverty, and declared that the church should hold no possessions whatsoever. The war raged fiercely till 1250. At first, fortune was on the side of Frederick; but the revolt of Parma in 1247 was the turning-point of the struggle. From that date he was uniformly unfortunate. For a long time the spirit of Frederick remained unbent; the number of his enemies only strengthened his resolution. But constant defeat rendered him suspicious and in 1249 he arrested, on a charge of treason, and blinded Pierre de la Vigne. In the same year, Frederick's son, Enzio, was captured by the Bolognese. Successes in 1250 in Lombardy and in Germany encouraged Frederick to undertake another expedition into Upper Italy, but he was immediately seized with illness, and died in Lower Italy in the arms of his favourite son Manfred, Dec. 13, 1250. His body was buried in Palermo.

Frederick II. united to a fine personal figure and chivalrous courage a high degree of culture, and a taste for science and the arts. In his modes of thinking, his manners, and his life, he committed many offences against the ideas of his age and the dogmas of the church, abandoning himself without restraint to sensuality and scepticism. Hence he appears in Dante's Inferno in the number of those bold heaven-storming doubters, who, as a punishment, are condemned to lie in fiery graves.

FREDERICK AUGUSTUS II. and III., electors of Saxony and kings of Poland. See AUGUSTUS.

FREDERICK II., King of Prussia, the greatest monarch of the eighteenth century, was born January 21, 1712. He was the son of Frederick William I., and the Princess Sophia Dorothea of Hanover. Although, by the direction of his father, he was instructed only in the details of military exercises and service, his taste for poetry and music was early developed by the influence of his first instructress, the highly gifted Madame de Rocoules, and his early

teacher, Duhan, who, countenanced by the queen, formed a secret opposition to his father's system of education. The prince's inclination led him to adopt entirely the views of his mother. This gave rise to a coolness between him and his father, which was increased by the minister Von Grumbkow and Leopold, prince of Anhalt-Dessau, to promote certain plans of their own, and by the Austrian ambassador, Von Seckendorf, for different reasons.

Indignant at the oppression and hatred which he experienced from his father, Frederick determined to flee to the court of George II., king of England, his mother's brother. His sister Frederica, and his friends Lieutenants Katt and Keith, were the only persons intrusted with the secret of his flight. He intended to start from Wesel, whither he had accompanied his father. Some incautious expressions of Katt betrayed the intentions of the prince. He was overtaken, was barbarously treated by his father, and obliged to be an eye-witness of the execution of his friend Katt. Keith made his escape from Wesel, and lived in Holland, England, and Portugal, till Frederick's accession to the throne, when he returned to Berlin in 1741, and was made lieutenant-colonel, equerry, and curator of the Academy of Sciences.

Whilst the prince remained in the closest confinement in Küstrin, the king sent a proposal to him to renounce the succession in favour of his younger brother Augustus William, on condition that he should have the liberty of pursuing his own inclinations in regard to his studies, travelling, &c. 'I accept the proposal,' said the prince, 'if my father declares that I am not really his son.' Upon this answer the king, who looked on conjugal fidelity with religious respect, relinquished his plan. That the king was inclined to sentence his son to death is certain. But the provosts Reinbeck and Seckendorf, who had before intrigued against the prince, now saved his life; the latter, in particular, by availing himself of the interference of the emperor.

The prince was not admitted to court till on occasion of the nuptials of his sister Frederica, and was obliged by his father in 1733 to marry the Princess Elizabeth Christina, daughter of Ferdinand Albert, duke of Brunswick-Bevern. Frederick William gave the castle of Schönhausen to her, and to the prince the county of Ruppin, and in 1734 the town of Rheinsberg, where he lived devoted to study till he ascended the throne. Among his daily visitors were literati, musicians, and painters. He corresponded with foreign scholars, particularly with Voltaire, whom he greatly admired. Several of his writings, in particular his Antimacchiavel, had their origin in the rural tranquillity of Rheinsberg.

The death of his father raised him to the throne, May 31, 1740. Frederick, on his accession, found in his states a population of only 2,240,000. At his decease he left 6,000,000. He raised Prussia to this pitch of greatness by his talents as a legislator and general, assisted in the field and in the cabinet, during a reign of forty-six years, by many distinguished men. His father, in expectation of a war on account of the succession of the Duchy of Juliers, had an army of 70,000 men on foot. Frederick II., who had already excited great expectations, retained for the most part the institutions and laws of his father, but gave to the latter more extent and vigour. The death of the Emperor Charles VI. was a favourable moment, of which Frederick II. took advantage, to revive the claims of the house of Brandenburg with regard to the Silesian principalities, Jägerndorf, Liegnitz, Brieg, and Wolau, so far as to ask from the queen, Maria Theresa, the duchies of Glogau and Sagan, in return for which he promised her assistance against all her enemies, his vote for the election of her husband as emperor, and 2,000,000 Prussian dollars. But these proposals being rejected, he occupied Lower Silesia in December, 1740, and defeated the Austrians under Neipperg, April 10, 1741, near Molwitz. This victory, which was almost decisive of the fate of Silesia, raised new enemies against Austria. France and Bavaria united with Prussia, and the war of the Austrian Succession commenced. The only ally of the Queen of Hungary and Bohemia, George II. of England, advised her to make peace with Prussia, because Frederick II. was her most active and formidable enemy. After the victory of Czaslau (Chotusitz), gained by Frederick May 17, 1742, the first Silesian war was terminated by the preliminaries signed at Breslau under British mediation (June 11), and by the peace signed at Berlin July 28, 1742. Frederick obtained Lower and Upper Silesia, and the county of Glatz, with the exception of Troppau, Jägerndorf, and Teschen, with full sovereignty. On the other hand, Frederick renounced all claims to the other Austrian territories, assumed a debt of 1,700,000 Prussian dollars charged upon Silesia, and promised to respect the rights of the Catholics in Silesia. Saxony acceded to this peace, of which England and Russia were the guarantees.

Frederick II. seized the opportunity of a peace to introduce useful institutions into the conquered territories, and to render his army more formidable. In 1743, on the death of the last Count of East Friesland, he took possession of that country, the reversion of which had been granted to his family in 1644 by the emperor. The war of the Austrian Succession continued; the Emperor Charles VII. was driven from his hereditary estates of Bavaria, and the Austrians were everywhere victorious. Frederick therefore, apprehensive that an attempt would be made to recover Silesia, entered into a secret alliance with France (April, 1744), and with the emperor, the palatinate, and Hesse-Cassel, at Frankfort (May 22, 1744). He promised to support the cause of the emperor by the invasion of Bohemia, on condition that he should receive the circle of Königgrätz. He entered Bohemia suddenly, August 10, 1744, and captured Prague; but the Austrians and Saxons under Charles, prince of Lorraine, compelled him to evacuate Bohemia before the close of the year. The death of the emperor (January 18, 1745), and the defeat of the Bavarians at Pfaffenhofen, obliged Maximilian Joseph, the young elector of Bavaria, to conclude the Peace of Fuessen with Maria Theresa, and occasioned the dissolution of the Alliance of Frankfort, after Hesse-Cassel had already declared itself neutral. Besides this, Austria, England, the Netherlands, and Saxony had entered into an alliance at Warsaw (January 8, 1745), and Saxony had concluded a separate treaty with Austria against Prussia (May 18, 1745). But Frederick defeated the Austrians and Saxons (June 4, 1745) at Hohenfriedberg (Striegau) in Silesia, entered Bohemia, and gained a second victory at Sorr, after a very obstinate combat, September 30, 1745. The victory of the Prussians under Leopold, prince of Dessau, over the Saxons at Kesselsdorf, December 15, 1745, led to the Peace of Dresden (December 25), on the basis of the Peace of Berlin. Frederick retained Silesia, acknowledged the husband of Maria Theresa, Francis I., as emperor, and Saxony promised to pay 1,000,000 Saxon dollars to Prussia.

During the eleven following years of peace Frederick devoted himself with the greatest activity to the domestic administration, to the improvement of the army, and at the same time to the muses. It was at this time that he wrote his Mémoires pour

servir à l'Histoire de Brandenbourg, his poem L'Art de la Guerre, and other works in prose and verse. He encouraged agriculture, the arts, manufactures, and commerce, reformed the laws, increased the revenues of the state, perfected the organization of his army, which was increased to 160,000 men, and thus improved the condition of the state.

Secret information of an alliance between Austria, Russia, and Saxony gave him reason to fear an attack and the loss of Silesia. He hastened to anticipate his enemies by the invasion of Saxony (August 24, 1756), with which the Seven Years' war, or third Silesian war, commenced. The Peace of Hubertsburg (February 15, 1763), of which those of Breslau (1742) and Dresden (1745) were the basis, terminated this war, without any foreign interference, on the principle that the contracting parties should remain *in statu quo*. Frederick came out of the Seven Years' war with a reputation which promised him, in the future, a decisive influence in the affairs of Germany and Europe. His next care was the relief of his kingdom, drained and exhausted by the contest. He opened his magazines to furnish his subjects corn for food and for sowing. To the peasants he distributed horses for ploughing, rebuilt at his own expense the houses destroyed by fire, established new settlements, built manufactories, and laid out canals. Silesia was excused from all taxes for six months, the Neumark and Pomerania for two years. In 1764 Frederick founded the Bank of Berlin, with a capital of 8,000,000 Prussian dollars. His attempt, in 1766, to organize the excise on the French system met with great censure. Several good institutions were established during this interval of peace; but the new code of laws was completed and carried into operation under his successor.

A treaty was concluded with Russia (March 31, 1764), in consequence of which Frederick supported the election of the new King of Poland, Stanislaus Poniatowski, and the cause of the oppressed Dissidents in Poland. For the purpose of connecting Prussia with Pomerania and the Mark, and of enlarging and consolidating his territories, Frederick consented to the first partition of Poland, which was first proposed at St. Petersburg, and concluded August 5, 1772. Frederick received the whole of Polish Prussia (which had been ceded to Poland by the Teutonic Order in 1466) with the part of Great Poland to the river Netz, excepting Dantzig and Thorn. From this time the Kingdom of Prussia was divided into East and West Prussia. The king erected a fortress at Graudenz, and established a council of war and of the domains at Marienwerder. The plans of the Emperor Joseph II. could not escape his vigilance. He declared against the possession of a large part of Bavaria by Austria in 1778, after the death of Maximilian Joseph, elector of Bavaria, without issue. Charles Theodore, elector of the Palatinate, inherited as the next heir, and had consented to a cession; but the Duke of Deux-Ponts, presumptive heir of the Bavarian Palatinate, and the Elector of Saxony, who had also claims to the inheritance of Bavaria, refused to acknowledge this cession. Austria was not to be diverted from her designs by negotiations. Saxony therefore formed an alliance with Prussia, and Frederick invaded Bohemia with two armies (July, 1778). The Emperor Joseph kept his position in a strongly-fortified camp behind the Elbe, near Jaromierz, and could not be induced to give battle. The aged Empress Maria Theresa wished for peace. Negotiations were commenced in the monastery of Braunau (in August), but were broken off without being brought to any result. But Catharine II. having declared her intention of assisting Prussia with 60,000 men, this war of the Bavarian Succession was terminated without a battle by the Peace of Teschen (May 13, 1779). Frederick had generously declared in the beginning of the negotiations that he would not demand any reimbursement of the expenses of the war. Austria consented to the union of the principalities of Franconia with Prussia, and renounced the feudal claims of Bohemia to those countries. In the evening of his active life Frederick concluded, in connection with Saxony and Hanover, the confederation of the German princes, July 23, 1785.

An incurable dropsy hastened the death of this great king. He died at Sans-Souci, August 17, 1786, in the seventy-fifth year of his life, and the forty-seventh of his reign, and left to his nephew, Frederick William II., a kingdom increased by 29,000 square miles, more than 70,000,000 Prussian dollars in the treasury, an army of 200,000 men, great credit with all the European powers, and a state distinguished for population, industry, wealth, and science. Improved by severe experience before he ascended the throne, animated by the example of his father, and possessed of rare talents, ripened in the solitude of Rheinsberg, Frederick seized the helm of government and shook the whole political system of Europe when he drew his sword in defence of his rights as a member of the empire, and of the rights of his house against the encroachments and the tyranny of the emperors, when he conceived and established, in accordance with the wants of his time, the confederation of princes, the master-work of his policy. One of his great merits is that, in the most difficult circumstances, he contracted no public debts, but on the contrary, although he distributed a considerable part of his revenues in different ways among his subjects, he had a richer treasury than any monarch in Europe ever possessed. His contempt for ecclesiastical establishments, which was considered by his contemporaries as a contempt of religion, has been censured, and his writings show that his heart was a stranger to the highest sentiments of piety. Entirely unacquainted with the literature and mental cultivation of Germany, he underrated it, and contributed nothing to its improvement. It must, however, be confessed that the German muse was not very attractive at the time when Frederick devoted himself to French literature; and when a higher spirit was infused into it by Lessing, Goethe, and Kant the king, crowded with occupations, was too strongly fixed in his tastes and studies to be affected by it. A passage in his writings shows that he anticipated a brighter day for German literature, without the hope of seeing it himself.

Some of Frederick's writings were published during his lifetime, but most of them appeared first in the Œuvres Posthumes (15 vols., Berlin, 1788–89; supplement, 5 vols.). In 1846–57 the Berlin Academy published a critical edition of the whole together with his literary and private correspondence, under the title Œuvres de Frédéric le Grand (31 vols.). In 1879 the same academy began the publication of Frederick's political correspondence, together with the military correspondence relating to the Seven Years' War. Three volumes of Preussische Staatsschriften aus der Regierungszeit Friedrich's des Grossen were published by Koser and Krauske in 1877–92. Posner has edited his Histoire de mon Temps (Leipzig, 1879), and Spitta edited his Musical Works (4 vols., Leipzig, 1889).

The government of Frederick was an autocracy, and its consequences showed themselves most disadvantageously in the civil administration, which practically became a mere machine. His talents, his army, his treasure, were his sole means of government. The consequence was that the separation between

the citizens and the military rose to an unexampled height in the Prussian monarchy. But it must be acknowledged that Frederick was popular in the noblest sense of the word—that he was the man of the nation. He lived, indeed, in the midst of his people. Each of his subjects was proud of him, and addressed him without fear, for the king considered himself as only the first officer of the state. See Carlyle, History of Friedrich II. of Prussia, called Frederick the Great.

FREDERICK III., King of Prussia, second Emperor of modern Germany, and son of William, first emperor, was born at Potsdam in 1831. He early entered the army of Prussia, and when the latter declared war against Austria in 1866 the Crown Prince, as he was called, became commander of the army of the Oder. By a series of rapid marches from Silesia through the Sudetic mountain passes into Bohemia his army arrived just in time to aid Prince Frederick Charles and snatch the decisive victory of Sadowa. At the outbreak of the Franco-German war he commanded the 3d German army, which numbered about 200,000 men, and with these he advanced to attack the French under Macmahon. The first assault was made at Weissenburg (Aug. 4), and two days later he successfully turned the French defence at Woerth, causing the disorderly retreat of Macmahon's army. Later in this campaign he pressed northward closely after Macmahon, and the passage of the Meuse by the Germans under his command greatly contributed to the successful turning of the French advance, and the final surrender at Sedan. This accomplished, he pushed on to Paris, and after surrounding the city established his head-quarters at Versailles, where he remained until the capitulation in January, 1871. In 1887 he was attacked by a serious throat disease, which proved ultimately to be of a cancerous nature. While undergoing treatment at San Remo his father died, and in his weakness he suddenly found himself (Mar. 1888) required to fulfil the duties of an emperor. This he did with cheerful patience and fortitude until on June 15, 1888, death brought him release. This announcement was received with wide regret, for his renown as a military commander, his liberal views, his large-heartedness, and his noble resignation under suffering, had touched his personality with the rarest heroic qualities. His widow, the ex-Empress, to whom he was married in 1858, is the Princess Royal of Britain, eldest daughter of Queen Victoria.

FREDERICKSBORG, or Hillerød, a town, Denmark, Seeland, 22 miles N.N.W. of Copenhagen. Its great attraction is a palace containing the richly-decorated chapel in which the Danish kings are crowned. The interior of both the castle and chapel were burned in 1859, but have since been restored. Pop. about 2500.

FREDERICKSBURG, a town, United States, Virginia, capital of Spottsylvania county, on the right bank of the Rappahannock, 60 miles north by east of Richmond. Here the Federal forces under Burnside were defeated by the Confederates under Lee on the 13th Dec. 1862. Pop. (1900), 5068.

FREDERICK WILLIAM, of Prussia, known as the *Great Elector*, was born in 1620, and at the age of twenty succeeded his father as elector of Brandenburg. His reign began when the unhappy Thirty Years' war was still raging in Germany, and his conduct towards both parties was prudent. In 1641 he concluded a treaty of neutrality with Sweden, notwithstanding the earnest remonstrances of Austria. In 1644 he concluded an armistice with Hesse-Cassel, by which Cleves and the county of Mark were restored to him, and by the Peace of Westphalia, in 1648, he received Magdeburg, Halberstadt, and Kammin. He directed his attention towards the army, and greatly improved it. In the war between Poland and Sweden (in 1655) he was obliged to take part, on account of the Duchy of Prussia. He supported both parties in turn, and obtained an acknowledgment of the independence of the Duchy of Prussia from Poland, upon whom it was formerly dependent. In 1672 he concluded a treaty with the Dutch Republic, when this state was threatened by Louis XIV. Though the French retreated from the Netherlands when Frederick William advanced into Westphalia, the success of the whole war was frustrated by the slowness of the Austrian generals and their jealousy of the elector. On June 6, 1673, he concluded a treaty with France at Vossem, near Louvain, by which France promised to evacuate Westphalia, and to pay 800,000 livres to the elector, who, in return, broke off his treaty with Holland, and promised not to render any aid to the enemies of France.

In 1674 the German Empire declared war against France. The elector marched 16,000 men into Alsace, but Bournonville, the Austrian general, avoided a battle, which was ardently desired by the elector, and Turenne defeated the imperial army at Mühlhausen. In the following December a Swedish army, at the instigation of France, entered Pomerania and the Mark. The elector hastened back and defeated them, June 18, 1675, at Fehrbellin, with 5600 cavalry. In 1678 he concluded a separate peace with France, at Nimeguen, as did also Holland and Spain. France demanded the restoration of all the conquered territories to Sweden. The elector, having refused compliance, formed an alliance with Denmark, and waged a new war against Sweden, but was at last obliged to submit, by the Peace of St. Germain, June 29, 1679. He received from France 300,000 crowns. Louis XIV. having occupied several circles of Alsace by his famous *chambres de réunion*, Frederick William effected an armistice of twenty years between France and Germany (in 1684). But when he renewed (1685) his treaty with Holland, and received into his dominions about 14,000 Protestant refugees from France, new difficulties arose between him and France, which brought him into a closer connection with Austria. He received the circle of Schwiebus in 1686, and in the same year sent 8000 men to assist the Austrians against Turkey.

The elector paid great attention to the promotion of agriculture and horticulture, and, by affording protection to the French refugees, gained 20,000 industrious manufacturers. He died at Potsdam, April 29, 1688, and left to his son a country much enlarged and improved, an army of 28,000 men, and a well supplied treasury. A colossal statue of Frederick William in bronze, at Berlin, was cast by Jacobi, in 1700, and is still one of the greatest ornaments of that city.

FREDERICK WILLIAM I., King of Prussia, son of Frederick I., and father of Frederick the Great (II.), was born in 1688, and displayed a passion for military exercises at an early age. While crown-prince (1706) he married Sophia Dorothea, daughter of the elector of Hanover, afterwards George I. of England. On his accession to the throne, in 1713, he endeavoured to increase the army and reform the finances, and became the founder of the exact discipline and regularity which have since characterized the Prussian soldiers. Soon after his accession he was recognized as King of Prussia in a treaty with France. Frederick was unwilling to engage in the war between Charles XII. and Russia, Poland, and Denmark; but Charles, for whom he had a great esteem, having made a body of Prussians prisoners, he immediately declared war. His troops under Leopold of Dessau

played an important part in the capture of Stralsund. He afterwards interfered in favour of the Protestants of some neighbouring countries, and he liberally rewarded the introducers of useful arts. But being void of science and ornamental literature, he regarded them with contempt, and treated their professors with every kind of discouragement. Poetry and philosophy were equally his aversion. He banished Wolf for his metaphysical opinions, and his own son, who had acquired a partiality for polite literature and music, was so continually thwarted by the king, that he determined to quit Prussia. In 1734 he fell into a bad state of health, which increased the natural violence of his temper, and he behaved with the greatest brutality to his physicians. He died in 1740, after having been reconciled to his son, and expressed the greatest regard for him. He expired in his arms. He left behind him an abundant treasury, and an army of about 70,000 men. His affairs were in the greatest order and regularity, and to his energy was Prussia much indebted for that prosperity and success which distinguished her till she was humbled by the power of Napoleon.

FREDERICK WILLIAM IV., King of Prussia, born on the 15th of October, 1795, was the son of Frederick William III. and his admirable queen, Louisa. He was carefully trained by the best masters in all the leading branches of knowledge and art, civil and military. During his boyhood the fortunes of Prussia were at their lowest ebb, for she had been shorn by Bonaparte of a large extent of territory, and lay helpless under his iron heel; but as he approached manhood the war of Independence began, and he took part, though without any active command, in the campaigns of 1813-14. When he succeeded to the throne by the death of his father in 1840 he had attained the mature age of forty-five, and having long been a member of the council of state was not new to the duties which he was called upon to discharge. His first proceedings were both of a popular and praiseworthy character. He granted an amnesty for political offences, surrounded his throne with some of the most distinguished men of the age, relieved the press from several of the shackles which bound it, and declared in favour of constitutional government. His subsequent policy did not fulfil its earlier promise, and was characterized by a reactionary spirit. He encouraged the duchies of Schleswig and Holstein in their insurrectionary movement, and sent some troops to assist them against the Danes, but he soon after abandoned their cause. One of his leading aspirations was a unification of Germany under the hegemony of Prussia, but the revolutionary spirit of the Frankfort diet induced him to reject the imperial crown which they offered him. The popular movement which followed the French revolution of 1848 was at first met by the king with firmness, but on the demand of the people that the troops should be withdrawn from the capital, backed by an attack on the arsenal, the king offered concessions, which, however, he retracted on his power becoming more secure. It seems to be generally admitted that he wished to govern well; but his high notions of prerogative too often defeated his intentions, and placed him in the hands of ministers who turned his failings to account for the furtherance of their own views, and thus made his reign retrograde and unpopular. A blunder, which for the time reduced Prussia to the rank of a second-rate power, was his affected neutrality, with a visible leaning to Russia, during the Crimean war. Latterly his mind gave way, and he sank into a state of imbecility, which rendered it necessary to appoint his brother regent. He died without issue 2nd January, 1861, and was succeeded by his brother the emperor, William I.

FREDERICTON, a town in the Dominion of Canada, capital of New Brunswick, situated on the river St. John, about 84 miles from its mouth and 54 miles N.N.W. of the town of St. John. It is well laid out, and has handsome public buildings, including the government house, the provincial buildings, courthouse, town-hall, cathedral, university, &c. The trade is extensive (especially in timber), and is increasing, the river being navigable for large steamers. Pop. (1891), 6502; (1901), 7117.

FREDERIKSHALD, or FREDERIKSHALL, a seaport, Norway, at the mouth of the Tistedal in the Ide-fiord. It is well built, and has a good and safe haven. Immediately to the south, on a rock about 400 feet high, stands the fortress of Frederiksteen, at the siege of which Charles XII. of Sweden was killed, 30th November, 1718. An obelisk marks the spot. Pop. (1891), 12,307; (1900), 11,957.

FREE CHURCH OF SCOTLAND. The Free Church of Scotland was organized as a separate body from the Established Church in May, 1843. The General Assembly of the National Church was convoked to be held in Edinburgh on the 18th day of May in that year. The members had been elected and were convened in the usual manner, and the queen's commissioner had taken his place, accompanied by the principal officers of state in Scotland, when the Rev. Dr. David Welsh, who had been moderator of the last Assembly, instead of constituting the meeting in the ordinary manner, rose and read a protest which had previously been prepared, as the result of years of controversy in the church courts, and of fruitless negotiations with government and Parliament, on the subjects embodied in the document. The following allegations were set forth at large in the protest:—1. That the courts of the Established Church are liable to be coerced by the civil courts in the admission to the office of the ministry, and in constituting the pastoral relation, and are subject to be compelled to intrude ministers on reclaiming congregations. 2. That the civil courts have power to interfere with and interdict the preaching of the gospel and the administration of ordinances. 3. That the civil courts have power to suspend spiritual censures pronounced by the ecclesiastical courts against ministers and probationers of the church. 4. That they have power to reduce and set aside sentences of the church courts deposing ministers and depriving probationers of their license. 5. That they have power to determine on the right of persons to sit as members of church courts, and to interdict their sitting and voting therein. 6. That they have power to supersede the majority of a church court, and authorize the minority to exercise its functions. 7. That they have power to stay processes of discipline pending before courts of the Established Church. And 8. The protest alleged that no pastor could be admitted into the church courts of the Establishment, and no additional provision made for the exercise of spiritual discipline among the members of the church without the sanction of a civil court. The protest concluded by asserting the right of the protesters, in these circumstances, to withdraw to a separate place of meeting for the purpose of taking steps for themselves and their adherents—maintaining with them the Confession of Faith and Standards of the Church of Scotland as heretofore understood—for separating in an orderly way from the Establishment. After reading this document the moderator and other members of assembly, together with those adhering to them, withdrew to another place of meeting (the Tanfield Hall, Canonmills), and were constituted as the Free Church of Scotland. They elected Dr. Chalmers as their moderator, and proceeded with the business before them in the ordinary form. Although thus

disestablished, and for conscience' sake denuding themselves of the temporal benefits of an Establishment, they held and declared themselves to be the true national church of the Reformation. The deed of demission was signed by 474 ministers and professors. To these, in due time, were added the foreign missionaries, who to a man sent in their adhesion to the Free Church. The great proportion of the elders, together with almost the whole body of Sabbath-school teachers and fully a third part of the population of Scotland, were speedily found arrayed on the side of the Free Church. A sustentation fund was instituted for the maintenance of the ministers, to be made up by the voluntary offerings of the people, and equally divided at the end of every year, the dividend being supplemented to each minister by his own congregation. In the first year after the Disruption the sum of £366,719 was contributed for the erection of churches, between 700 and 800 of which had to be provided. Colleges for the theological training of the ministry were subsequently erected in Edinburgh, Glasgow, and Aberdeen. Numerous schools were built, and normal schools for the training of teachers were instituted in Edinburgh and Glasgow. Manses also were built, and the funds raised by the church during the first ten years amounted to £3,000,000.

The Free Church adopted no new article of faith—originated no new doctrine, discipline, or ritual. She carried with her out of the Establishment her old ecclesiastical laws, the Confession of Faith and Catechisms, the form of church government, and the ritual which had been received and observed in the national church. She abandoned nothing but the endowments of the state, and that not because her ministers and members had changed their views of the alliance which ought to subsist between the church and the state, or had adopted the opinion that it is unlawful for the church to receive the endowments of the state, but solely because they believed the government of the country, through the voice of Parliament and the decrees of its civil tribunals, had altered the essential conditions under which the Established Church had hitherto acted. The ministrations of the Free Church soon extended to every district, and nearly every parish in the land.

From about 1867 there was a movement in favour of the union of the Free and United Presbyterian Churches of Scotland, and on Oct. 31st, 1900, the union was formally completed by the constitution at Edinburgh of the first assembly of the United Free Church of Scotland, under the moderatorship of Dr. Rainy. The great majority of the Free Church entered into the new body, and continued to hold the churches, manses, and other property of the older body; but a small minority of Free Church ministers and members who refused to accept the union, claimed to be the true Free Church of Scotland, and maintained separate presbyteries and synods and a distinct General Assembly under that name. They also laid claim to the property and funds of the pre-Union Free Church, alleging that those who had entered into union with the United Presbyterian Church had abandoned essential principles of the Disruption Church, including the Establishment principle and certain doctrines of the Westminster Confession of Faith. The property question was taken to the law courts. The Court of Session decided in favour of the United Free Church. On August 1, 1904, however, the House of Lords reversed this decision on appeal. The final decision, which resulted from a strict application of trust law to the case, was received with dismay by the United Free Church, and roused keen feelings in many ecclesiastical circles. How matters may be finally adjusted it is yet too early to judge.

FREE CITIES. The cities of Germany originated chiefly during the reign of the Carlovingians and the emperors of the Saxon house, and remained for a long time dependent on the secular or spiritual nobility, who often exercised their authority in a very oppressive manner. The disturbances under Henry IV. (1050–1106) encouraged the inhabitants of Worms and Cologne to arm themselves. They offered their services to the emperor, who gladly accepted the offer, which his embarrassed situation rendered very agreeable. Commerce and manufactures gradually increased the importance of several other cities; they frequently assisted the emperors in repressing the arrogance of the nobles, and, in return for their services or contributions, received various privileges and immunities. In this manner the imperial cities originated in the middle of the twelfth century. It has, however, been proved that there were free cities in Germany which existed from the time of the Romans, and had little in common with the free cities of later times, and which, in the beginning of the sixteenth century, lost their most essential privileges, and even the name of free cities, through the ignorance and carelessness of their magistrates. The most important of those privileges were, that they should enjoy an independent government; should never swear allegiance to any emperor or king, nor be obliged either to engage in any expedition against the Romans, or to pay for the privilege of exemption; nor pay any contributions whatsoever to the empire; nor be in any way reckoned among the cities of the empire. In one word, until the period above mentioned, they constituted independent republics. The cities of Lombardy, enriched by commerce and encouraged by the assistance of the popes, often ventured to resist their masters, the emperors, and could not be reduced to obedience without great difficulty. The example of the cities of Lombardy also encouraged those of Germany. In the middle of the thirteenth century two important confederacies were established for common objects—the Hanseatic League (1241) and the league of the Rhenish cities (1246). The powerful Hanseatic League lasted nearly four centuries, until its dissolution was effected by several causes in 1630. The remnant of this league and of the former *collegium* of cities, which had its representatives in the German diet, namely the free cities of Hamburg, Bremen, and Lübeck, was incorporated with the French Empire in 1810. As these cities co-operated vigorously in the recovery of German independence, they were acknowledged, together with Frankfort-on-the-Main, as free cities by the Congress of Vienna (1814–15). As such they joined the German Confederacy, and obtained the right of a vote each in the diet, and one among the four in the narrower council. In conformity with the twelfth article of the constitution of the German Confederacy, they established a common supreme court of appeal in 1830. Besides these four free cities in Germany, Cracow was likewise declared a free city by the general act of the Congress of Vienna, under the protection of Russia, Austria, and Prussia. Advantage, however, has been taken of the Polish insurrections to declare its privileges forfeited, and Austria has incorporated it with her other territories, while Frankfort has since 1866 been annexed to Prussia. Accordingly the only free cities now existing are Hamburg, Lübeck, and Bremen, each sending a member to the Bundesrath, and Hamburg three deputies to the Reichstag, the others one each.

FREEDMEN (*liberti, libertini*) was the name applied by the Romans to those persons who had been

released from a state of servitude. The freedman wore a cap or hat as a sign of freedom (hence the origin of the cap of liberty), assumed the name of his master, and received from him a white garment and a ring. With his freedom he obtained the rights and privileges of a Roman citizen of the plebeian rank, but could not be raised to any office of honour. He always remained in a certain moral dependency (*vinculum pietatis*) on his former master. They owed each other reciprocal aid and support. At a later period the number of emancipated slaves increased to such an alarming extent that they even became formidable to some weak emperors by the power and wealth they had acquired, and many laws were passed for the purpose of diminishing their number. Besides emancipation by testament, two other modes were in use. The one consisted in the master causing his slave to be enrolled in the list of citizens by the censor. The other was the more solemn. The master, leading his slave by the hand before the prætor or consul, declared, 'I desire that this man be free, according to the custom and usage of the Romans.' If the latter consented, he gave the slave a blow on the head with a rod, saying, 'I declare this man free, according to the custom of the Romans.' The lictor, or the master of the slave, then turned him round, gave him a blow on the cheek, and let him go, intimating that he might depart where he pleased. The whole proceeding was entered on the registers of the prætor, and the slave received a cap or hat, the badge of freedom, in the temple of Feronia.

FREEDOM. The freedom of a city or borough is the right of enjoying the privileges and immunities that belong to the burgesses or freemen, such as electing the council or the parliamentary representative. In certain boroughs there are freemen by birth or marriage not on quite the same footing as burgesses. See FREEMAN'S ROLL, BOROUGH.

FREEHOLD, in law, property held in fee-simple, fee-tail, or for term of life; or the tenure by which lands or tenements are held for life. When the interest extends beyond the owner's life it is a *freehold of inheritance*. Most land in England is freehold. See FEE, LAND (TENURE OF), COPYHOLD.

FREE-LANCES, companies of knights and men at arms who, in the middle ages, wandered from state to state offering their services to any party able and willing to hire them. They were chiefly employed in Italy, where they were known as Condottieri (which see).

FREEMAN'S ROLL, a list of all persons admitted as burgesses or freemen of those rights reserved by the Municipal Corporation Acts (5 and 6 Will. IV. cap. lxxiv. and 45 and 46 Vic. c. 50), as distinguished from the burgesses newly created by the former act, and entitled to the rights which it confers who are entered on the burgess-roll.

FREEMASONRY, a term applied to the organization of a society, composed of persons calling themselves *free and accepted masons*, and to all the mysteries therewith connected. The origin of the institution has given rise to much fabulous narrative and idle speculation. Some enthusiastic writers on the subject, as for instance William Preston, in a treatise published in 1792, regard it as coeval with the creation of man. Others, more moderate, find its origin in the religious mysteries of the ancient world, and particularly in a supposed branch of those corporations of architects, who, under the name of the *Dionysiac Fraternity*, monopolized the building of temples, stadia, and theatres in Asia Minor, and recognized each other by signs and tokens. The masonic writers place the arrival of the Dionysiacs in Asia Minor at the time of the Ionic migration, about 1044 B.C., about half a century before the building of Solomon's temple, thus giving ample time for the establishment of the fraternity in the city of Tyre when Hiram was called upon to assist Solomon in his design; this he did by sending a band of Dionysiac workmen, at the head of whom was a widow's son, to whom is attributed the origin of freemasonry. The rituals which are used in the lodges of the order are based upon the supposition of the truth of this theory. Well-informed masons, however, give no credit to these pretensions to so remote an origin. Rebold, one of the best authorities on the subject, says there were many masonic corporations diffused throughout Europe in the beginning of the seventh century, known in Italy as Colleges of Architects, in France as Pontifical Brothers and as Free Corporations, and in England and Scotland as Freemasons, a name assumed in consequence of the extensive privileges they enjoyed as a corporation of builders. Dr. Henry, in his History of Great Britain, gives the following account of their origin: 'The Italians, with some Greek refugees, and with them French, Germans, and Flemings, joined into a fraternity of architects, procuring Papal bulls for their encouragement and their particular privileges; they styled themselves free masons, and ranged from one nation to another as they found churches to be built; their government was regular, and where they fixed near the building in hand, they made a camp of huts. A surveyor governed in chief; every tenth man was called a warden, and overlooked each nine.' In the tenth century the freemasons in England are said to have received the special protection of King Athelstan, who granted them a charter to hold their annual assemblies, and to frame the necessary laws for their government as a corporate body. They met at York in 926, and the regulations they there adopted, under the title of the Gothic Constitutions, were discovered by Mr. Halliwell in the old royal library of the British Museum. To this craft we owe the magnificent Gothic religious edifices of the middle ages, such as the cathedral of Strasburg, built between 1015 and 1439, and that of Cologne, founded in 1248, and continued for several centuries, besides many famous structures in England, Portugal, and Italy. The abbey of Kilwinning, in Scotland was raised by this fraternity in the thirteenth century, and the Kilwinning and York lodges are the most ancient in Britain; the grandmastership of the former was hereditary in the family of St. Clair of Roslin, while several English kings have consented to accept the corresponding dignity from the latter. From an early period many persons were admitted into the community who were non-operative masons or architects, such as statesmen, ecclesiastics, and persons of eminent ability; and in the course of time the operative character of the association began to be lost sight of. At what precise time the speculative element gained the pre-eminence over the operative we cannot say; the change was probably gradual. The diary of the English antiquary, Elias Ashmole, describes his initiation into the order in 1646; and Preston informs us that about thirty years before, when the Earl of Pembroke was made grandmaster, there were many wealthy, eminent, and learned men admitted. About 1714 a formal resolution was passed by the English Grand Lodge that the privileges of the order should no longer be restricted to operative masons, but extended to men of various professions, provided they were regularly approved and initiated. During the grandmastership of Sir Christopher Wren, who, becoming old and infirm, had neglected the interests of the institution, there were but four lodges in active work in the south of England; but shortly after his death those lodges met at the Apple-tree Tavern in Covent Garden, London, compiled and

collated the rules and regulations which had long been in existence, but for some time neglected, and passed several new ones, now become necessary since the speculative element of the society had so completely taken the place of its former both speculative and operative organization. Freemasonry, thus modified, soon began to spread over the world. In 1725 it was introduced into France by Lord Derwentwater; and in 1772 the two grand lodges (now united) of the Grand Orient and the Grande Loge de France were formed. In 1733 the first American lodge was established, and now there are in North America an enormous number of lodges. In Great Britain and Ireland the lodges number about 3000, some 2000 of these being in England. In each of the three kingdoms there is a Grand Lodge from which the other lodges derive their charters, and which exercise a general jurisdiction in masonic affairs. Each lodge has a master, warden, and other officers. The English lodges are especially remarkable for the amount of money they raise for benevolent purposes. Masonry flourishes greatly in the British Colonies. In spite of many attempts to suppress it by church and state in various countries of Europe, notably in Spain, Russia, and Austria, it is firmly planted in every part of the Continent, and has penetrated into Asia and Africa. It has been specially condemned by several popes, and Roman Catholics thus cannot become freemasons. Its organization in Europe is said to have been used for political purposes, and especially as a cloak to conspiracies against the governments. The employment of it for such purposes is, however, a violation of its constitution, which prohibits political or sectarian discussions in the lodges. There is usually understood to be a deep symbolical meaning couched under the peculiar language of the fraternity. A set of passwords and a peculiar grip of the hand enable the initiated to recognize each other, and give a zest to their friendly meetings. There is a not unimportant practical advantage attaching to membership of the body, in that it enables a mason in a place where he is a stranger to make himself known to his brother masons, and to claim their protection and assistance. See D. Murray Lyon's History of the Lodge of Edinburgh, No. 1, embracing an account of the Rise and Progress of Freemasonry in Scotland; Gould's History of Freemasonry; Mackey's Encyclopædia of Freemasonry, and Lexicon of Freemasonry; Paton's Freemasonry; &c.

FREE PORT, a harbour where ships of all nations may enter and load or unload on payment of harbour dues or charges for accommodation. Goods may be stored at free ports, and may then be either re-shipped for export, or they may be admitted for home consumption on payment of the usual full customs of the country. The bonded warehouse system effects the same end as free ports.

FREESTONE. See SANDSTONE.

FREE-THINKER, a term first applied late in the seventeenth, or early in the eighteenth century to those who reject revelation. Free-thinking, in England, first appeared in the form of opposition to abuses in the church, which were attacked in the reigns of James II. and William III. Dodwell, Steele, Anthony Collins, and John Toland are among the earliest English free-thinkers of eminence, and Collins expounded his doctrines in a work entitled A Discourse of Free-thinking (1713). In 1718 a weekly paper was published, entitled the Free-thinker, or Essays of Wit and Humour, &c. Math. Tindal (who died 1733), Morgan, and Bernard Mandeville, extended free-thinking to morals, but Lord Bolingbroke and Hume take the lead among free-thinkers. The English free-thinkers differed widely amongst themselves, having indeed little in common save the assertion of the right to exercise their reason in matters of religion. Nearly all were genuinely religious men, and few were materialists. Free-thinking also originated in France from the abuses of the church, but in that country it assumed a more philosophical and aggressive form. Voltaire and the encyclopædists D'Alembert, Diderot, and Helvetius (the author of the Système de la Nature), were known as free-thinkers, and the same spirit became fashionable in Germany. German free-thinkers have mostly been scholars whose studies have led them on to opposition to recognized religious principles or formulas. See J. M. Robertson's Short History of Free-thought (1899).

FREETOWN, a seaport of West Africa, capital of the British colony of Sierra Leone, on the south side not far from the entrance of the estuary or river of Sierra Leone, in the vicinity of extensive swamps, which make it very unhealthy. Its principal streets are broad and straight, and have, more especially in the part occupied by Europeans and the better class of native traders, a very attractive appearance, the houses being generally detached and surrounded by trees. Among the public buildings are several churches and chapels; technical, grammar, missionary, and other schools; a governor's house, and barracks. The market, held in a central square, is well supplied with tropical fruits and fish. Freetown is a strongly fortified imperial coaling-station. A railway runs from Freetown some distance into the interior. Pop. (1891), 30,033; (1901), 34,463.

FREE-TRADE, the term applied to national commerce when relieved from such interference as is intended to improve or otherwise influence it. Among the attempts made by governments to regulate trade for the communities under their rule two leading policies may be distinguished, the one prohibiting the exportation of commodities, the other encouraging exportation, and prohibiting or discouraging importation. It was long held by British statesmen that exportation was a source of wealth, and importation only a source of unremunerative expenditure. It was held to be of importance to encourage native production and manufactures by excluding from the home markets, and from the colonial markets over which there was control, the competing produce and manufactures of other countries. On this theory the great body of British commercial legislation was founded until 1846, when the policy of free-trade was introduced in the case of grain, and afterwards gradually extended by the repeal of the navigation laws in 1849 and other great measures, until nearly the whole commerce of Britain has been brought into conformity with it. Free-trade can hardly yet be said to have been adopted as a principle of commercial policy by any nation except Great Britain; and it has been distinctly repudiated by several of her most important colonies when left to legislate for themselves. What most materially contributed to its introduction in this country, besides its obvious adaptation to the circumstances of a country abounding in mineral wealth and possessing the greatest advantages for manufacturing and commercial progress, was the extremely objectionable character of the corn-laws (see CORN-LAWS). The idea of complete freedom in trade had indeed often been advocated by theorists, particularly among Italian and English economists, but it would probably have remained a theory if the English protectionists had been content with a moderate duty on corn. From an economic point of view the subject is not without difficulties. It is perfectly clear that in ordinary circumstances duties imposed purely for the protection of native industry are

simply mischievous; but it is equally evident that all taxation, however imposed, is a restriction upon trade; and if the incidence of taxation is such as to press more heavily upon home production than upon imports, it seems obvious that an injury will be inflicted on trade at least as great as if taxation is made to press more heavily upon imports than upon home production. To draw the line exactly requires a more scientific treatment of the subject than it has, perhaps, yet received.

During the discussions upon the introduction of free-trade in Great Britain a principle of the nature of a compromise was proposed under the term *reciprocity*. The policy indicated by this term was that of opening her ports by commercial treaties to those countries which agreed to give her corresponding advantages. This policy continues to be advocated, but is open to the objection that it would make her commercial policy dependent upon that of other countries, and it would certainly be absurd to retain duties which injured British trade merely because foreign countries refused to withdraw others. On the other hand, the advantages of mutual free-trade would undoubtedly be greater than those of free-trade on one side only. The principle of reciprocity has always been to some extent acted upon by nations in their commercial policy. It was adopted in the commercial treaty with France, negotiated in 1860 by Richard Cobden, the apostle of free-trade himself, and it might possibly, in the reconstruction of the commercial system, have been made freer use of with advantage. As applied to the individual and not to the nation, free-trade is the right of every man to do with his capital and abilities as he pleases; and as the universal desire of mankind is to improve their condition, the interests of the nation at large cannot be in better hands than in those of men who, by increasing their own wealth, are increasing the wealth of the public. The progress made by Britain since 1846 is often adduced as a striking illustration of this truth. Her annual exports at that period amounted to about forty millions, whereas they are now six or seven times as much. Adam Smith was the apostle of free-trade in Britain, and it has been advocated by Ricardo, M'Culloch, Mill, Cairnes, Fawcett, &c., and opposed by American writers generally, who favour protection. A very clear exposition of the subject will be found in The Free-trade Movement and its Results, by G. Armitage-Smith, M.A. (1898).

FREE-WILL. See WILL.

FREEZING, CONGELATION, or SOLIDIFICATION, the transformation of a fluid into a solid under the influence of cold. When solidification takes place suddenly, as in the case of water, molten iron, &c., and not gradually, as in that of pitch or sealing-wax, there is a particular point of temperature at which it occurs. The solid melts again at the same point; and, leaving out of account for the present a slight variation on account of pressure (see MELTING-POINT, INFLUENCE OF PRESSURE ON), we may say that the *freezing-point*, or the *fusing-point*, is a fixed point of temperature for any pure substance. Thus the melting-point of ice and the freezing-point of water is taken as a fixed point in our present system of thermometry. For the fusing-points of various substances see FUSING-POINT. During solidification heat is given out which is equivalent to the heat taken up during liquefaction. (See LATENT HEAT.) Thus a liquid exposed to a freezing-mixture, gets colder and colder under its influence *till solidification begins*. After that, although, as will be at once perceived, the freezing-mixture has lost none of its cooling power, the temperature of the body in question remains perfectly constant till the whole has been solidified, when the temperature begins to fall farther. This is due to the fact that heat is given out during the passage of a liquid into the solid condition. This will be found fully explained in the article LATENT HEAT. Freezing-mixtures, which are described below, depend for their action on the fact that a large quantity of heat is required for the mere conversion of a solid into the liquid form.

A matter which is worthy of notice here is the way in which the latent heat of vaporization is employed, together with the intense radiation that takes place under a clear sky, in the production of ice in hot countries. In some parts of India pits are dug in large open areas, the bottoms being strewn with sugar-canes, or dried stems of maize or Indian corn. Upon this bed are placed a number of unglazed pans, made of so porous an earth that the water oozes through their substance. These pans are filled towards evening with water which has been boiled, and are left in that situation till morning, when more or less ice is found in them, according to the state of the atmosphere; there being more formed in dry and clear weather than in cloudy weather, though colder. Everything in this operation is calculated to produce cold by evaporation. The beds on which the pans are placed suffer the air to have a free passage to their bottoms, and the pans, constantly oozing out the water to their external surface, are cooled by its evaporation. In order to obtain cool water for drinking porous earthen jars are often used, the outside of which is kept moist by the moisture which filters through the walls; and, being placed in a draught, the water in the jar becomes as cold as ice, though the wind is very warm. It is a common practice to cool wine or other liquors by wrapping a wet cloth round the bottle, and hanging it up in a draught. The water in the cloth evaporates, and thus cold is produced.

FREEZING-MIXTURE. The object of a freezing-mixture is to produce artificial cold. For this purpose two substances are mixed, of which one is usually solid, and which tend to form a liquid mixture. In liquefying any solid a certain amount of heat is made latent, and owing to this the temperature of the mixture at the end of the liquefaction is often very low indeed. Thus on mixing snow and salt together the salt converts the snow into water, or rather tends to form brine; but snow cannot melt without making latent a considerable quantity of heat. Hence the temperature of the brine which is the result of the mixture is very much below that of either the salt or snow. The fact is that salt and water mixed cannot be in the solid condition, except at a temperature very much below that of ordinary snow. The following is a list of freezing-mixtures, and of the lowering of temperature obtained by means of them. The substances, with the exception of the ice, mentioned in the second, are supposed to be mixed together at 10° C. (50° Fah.). Such mixtures are often employed in the making of ice-cream or water-ices, for cooling wine, &c. For producing ice on a commercial scale other means are required. See REFRIGERATING MACHINES.

Substances.	Parts by Weight.	Reduction of Temperature.
Sulphate of sodium,..	8	+ 10° C. (+ 50° Fah.) to − 17° C. (+1° Fah.)
Hydrochloric acid,....	5	
Powdered ice or snow,	2	+ 10°C. to − 18°C. (0° Fah.)
Common salt,.....	1	
Sulphate of sodium,..	3	+ 10°C. to − 19°C. (− 2° Fah.)
Dilute nitric acid,....	2	
Sulphate of sodium,..	6	+ 10°C. to − 26°C. (− 15°Fah.)
Nitrate of ammonium,	5	
Dilute nitric acid,....	4	
Phosphate of sodium,.	9	+ 10°C. to − 29°C. (− 20°Fah.)
Dilute nitric acid,....	4	

FREEZING-POINT. Liquids that are pure, that is those which are not mixtures, solidify always at the same temperature, which is called the freezing-point, and the solid melts again at the same temperature. Thus the freezing-point and the melting-point, or point of fusion, are synonymous, and the point is always the same for the same substance. Consequently the freezing-point of water or the melting-point of ice is taken for one of the two fixed points of temperature in thermometry. Professor James Thomson has, however, shown that a slight influence, perceptible with extremely delicate experimental arrangements, is exerted on the melting-point by the pressure under which the melting takes place. For such variations of pressure as the ordinary fluctuations of the barometer this variation may be absolutely neglected: and thus the freezing-point on the thermometer is determined by covering the bulb and stem up to the top of the mercurial column with snow or pounded ice, and marking off the point at which the mercury stands. See also MELTING-POINT (INFLUENCE OF PRESSURE ON).

FREGENAL DE LA SIERRA (ancient, *Nertobriga*), a town, Spain, Estremadura, in a valley on the right bank of the Martiga, 52 miles south by east of Badajoz. Manufactures: linen and woollen fabrics, leather, hats, soap, wine, and oil. Trade: grain, cattle, wool, flax, &c. Pop. (1897), 7908.

FREIBERG (Latin, *Friberga*), a town of Saxony, in the circle and 20 miles W.S.W. of Dresden, on the Münzbach, near the Mulde. It consists of an inner town still partly surrounded by old walls flanked with numerous towers, and of four suburbs. The ditches and ramparts have, for the most part, been filled up and levelled, and are now covered with planted alleys, ponds, and gardens. The principal buildings and establishments are the cathedral or Marienkirche, the mining academy, once under the celebrated geologist Werner, with a museum attached, particularly rich in the minerals of Saxony, and mining models; the royal silver refinery, the gymnasium, the orphan and military hospitals, blind asylum, workhouse, theatre, &c. Freiberg is the centre of a most important mining district. The minerals consist of silver, copper, lead, and cobalt; and the number of mines is said to be about 130. Pop. (1895), 29,287; (1900), 30,175.

FRIBOURG. See FRIBOURG.

FREIBURG, or FREYBURG, or FREIBURG IM BREISGAU, a town of Baden, in the circle of the Upper Rhine, on the Dreisam, and on the railway from Carlsruhe, in one of the most beautiful and fertile districts of South Germany, at the west foot of the Black Forest, 42 miles S.S.E. of Strasburg. It consists of the town proper, the fortifications of which have now been converted into pleasure-grounds, and of two suburbs, and is the seat of a superior civil and criminal court, and of several public offices. The buildings most deserving of notice are the münster or cathedral, a large and beautiful Gothic structure built of red sandstone, admired for its delicate symmetry and tasteful decorations, with a magnificent portal richly sculptured, and surmounted by a tower, partly of exquisite open work, 380 feet high; the university, founded in 1456; the merchant house, now the chief tax office, a quaint Gothic structure, resting on pointed arches, and decorated externally with fresco portraits of the Emperor Maximilian, his son Philip I., Charles V., and Ferdinand I.; and the grand-ducal palace and government buildings. The manufactures are numerous, but not individually of great extent. Freiburg is the see of an archbishop, and the seat of the courts and offices for the circle of the Upper Rhine. Pop. (1895), 53,118; (1900), 61,506.

FREIGHT is the consideration or money agreed to be paid for the use or hire of a ship; or, in a larger sense, it is the burden of such ship. The freight is most frequently determined for the whole voyage; but sometimes it depends on time. In the former case it is either fixed at a certain sum for the whole cargo, at so much per ton, barrel, or other weight or measure, or so much per cent. on the value of the cargo. See CHARTER-PARTY.

FREILIGRATH, FERDINAND, a German poet, born at Detmold June 17, 1810; died at Cannstadt, in Würtemberg, March 17, 1876. In 1838 he published at Mainz a volume of his collected poems, and as it proved successful he determined to devote himself entirely to literature. In 1842 he received a small pension from the King of Prussia; but this he retained for only two years, for having embraced views in politics of an advanced liberal stamp which placed him in opposition to the government, he felt bound to resign the benefits of royal favour. At the same time (1844) he published a poem entitled a Confession of Faith (Glaubensbekenntnis), in which he became the champion of the political creed he had adopted. He then found it advisable to quit Prussia, and retired first to Switzerland, and then to London, whence he returned to Germany at the time of the agitations of 1848. In this year other three political poems by him, Die Revolution, Februarklänge, and Die Todten an die Lebenden, saw the light; and the last of these led to his being put on trial for treason. This trial, in which he was acquitted, is memorable for another reason, being the first jury trial ever held in Prussia. From 1851 till 1867 Freiligrath again resided in England as manager of the London branch of a Swiss banking establishment. He was deprived of this position by the failure of the bank, whereupon a national subscription was got up in his behalf in Germany, and the proceeds of it enabled him to return to private life. His last years (from 1868) were spent at Cannstadt, where, as already mentioned, he died. The early poems of Freiligrath are distinguished by a wealth of glowing and highly-coloured imagery, and by the prevalence of oriental scenes and subjects. His political poems are too full of the tones of party warfare to live as poetry; but many of his lyrics, especially those which reflect the happy period of his life before he was disturbed by politics, in which he gave himself up entirely to poetry and letters, seem destined to hold an abiding place in German literature. Germany is also indebted to him for many admirable translations from foreign languages, as from Burns, Tannahill, Moore, Hemans, Shakspere, Longfellow, and Victor Hugo.

FREISING, a town, Upper Bavaria, at the confluence of the Moosach with the left bank of the Isar, 21 miles N.N.E. of Munich. It is well built, and has several handsome churches, one of them originally a cathedral, with a very ancient crypt, several distilleries, numerous breweries, and various other industrial establishments. Pop. (1900), 10,092.

FREJUS (ancient *Forum Julii*), a town, France, department Var, beautifully situated on a gentle slope above the Mediterranean, 15 miles south-east of Draguignan. It is a very ancient place, and has among its Roman antiquities remains of a port, quays, and lighthouse, a triumphal arch, an amphitheatre, and aqueduct. Bonaparte landed here in 1799 on his return from Egypt, and embarked here for Elba in 1814. Pop. 3050.

FRENCH-BEANS, or KIDNEY-BEANS, the *haricots* of the French, are the products of the *Phaseolus vulgaris*, supposed to be a native of the East Indies, but now commonly cultivated in all parts of the globe. This plant is a twining annual, bearing al-

composed of three oval pubescent folioles. The flowers are whitish, somewhat resembling those of the pea, and have the carina, style, and stamens twisted spirally. The seeds are more or less reniform, and are of all colours. A great number of varieties are cultivated, among which is that commonly called *Lima bean*. Within the tropics French-beans may be sown at all seasons of the year, but in temperate regions only in the spring, and usually near the latter part of the season, as the plants are very tender, and liable to be injured by frosts. A light, dry, and tolerably fertile soil is the most suitable, and if they are sown early a warm situation should be selected. Low and wet grounds are altogether unfit for them. Throughout all Europe and in America they are an important object of cultivation, and are eaten prepared in various ways.

FRENCH BERRIES, known also as Persian, Turkey, and yellow berries, are the fruit of dyer's buckthorn, *Rhamnus infectoria*. They yield a yellow colouring matter called *xanthorhamnin*, or *rhamnin*, and are largely used for dyeing paper and leather, for calico-printing, and for making certain paints.

FRENCH CHALK is a variety of steatite of a white or greenish-gray colour, with a soapy feeling, and easily cut with a knife. It is used for absorbing grease spots, for writing, by tailors for tracing the shape of garments upon cloth, and as a lubricating agent.

FRENCH HONEYSUCKLE (*Hedysarum coronarium*), a perennial of the natural order Leguminosæ, common in gardens, where it is grown for the sake of its beautiful scarlet (or white) flowers. In Sicily and Spain it is largely cultivated as a green crop, yielding an enormous quantity of herbage; but it seems to be too tender for Great Britain, disliking dampness and low temperature. In England it sometimes bears the name of Spanish sainfoin.

FRENCH LITERATURE, &c. See FRANCE.

FRENCH POLISHING. This process, now so generally employed for giving a smooth surface-coating to furniture and cabinet-work, is performed as follows:—The surface of the wood being finished off with glass-paper and placed opposite the light, the rubber (a ball of wool covered with rag), dipped in the varnish (or polish), is passed quickly and lightly over the surface in the direction of the grain of the wood, and rubbed till dry. This operation must be repeated several times. When the coating of varnish has acquired some thickness the inside of the rag is wetted with alcohol or wood-naphtha before applying more varnish, and a light uniform touch is given over the whole surface. The work lastly is carefully gone over with the rag moistened with a little oil and rectified spirit or naphtha, without varnish, and rubbed as before until dry. The most common of the varnishes known under the name of French polish are prepared as follows:—Pale shell-lac, 5½ oz.; finest wood-naphtha, 1 pint: dissolve. Or pale shell-lac, 3 lb.; wood-naphtha, 1 gallon. Methylated spirit (68 o.p.) may be substituted for the naphtha in the above formulæ. Before applying any of these varnishes the rubber must be first slightly moistened with raw linseed-oil. A preparation requiring no oil on the rubber is composed of the following ingredients: shell-lac, 8 oz.; wood-naphtha, 1 quart: dissolve, and add ½ pint linseed-oil. These varnishes are sometimes coloured to modify the character of the wood. A reddish tinge is given with dragon's blood or red sanders-wood, and a yellowish tinge by gamboge or turmeric-root.

FRERE, SIR HENRY BARTLE EDWARD, statesman and administrator, was born at Clydach, Brecknockshire, Wales, 29th March, 1815, died 29th May, 1884. He was educated at Bath Grammar School and Haileybury College; entered the East India Company's Civil Service in 1833; introduced improvements into the system of tax collection, and distinguished himself as an administrator. From 1847 to 1850 he was resident at Sattara, and at the latter date succeeded Sir Charles Napier as chief commissioner in Scinde. At the outbreak of the mutiny in 1857 he promptly seized the fortress of Multan, retained command over his own province, and was enabled to assist the neighbouring provinces. As a recognition of his services he was appointed a member of the Viceroy's Council, and in 1862 he became Governor of Bombay. Returning to England in 1867 he was knighted. In 1872, as British commissioner, he negotiated a treaty with the Sultan of Zanzibar abolishing the traffic in slaves. In 1875 he accompanied the Prince of Wales to India, and in the following year he received a baronetcy. In 1877 he was appointed Governor of the Cape, and high commissioner in South Africa to settle native and colonial affairs, but the war which he provoked with the Zulus gave so much dissatisfaction to the government that in 1880 he was recalled. A Life by J. Martineau appeared in 1895.

FRERE, JOHN HOOKHAM, a literary man of some eminence, uncle of the preceding, born in London on May 21, 1769, now chiefly remembered for his association with Canning, Gifford, and Ellis as one of the writers in the Anti-Jacobin Review at the close of the eighteenth century; and afterwards connected with the establishment of the Quarterly Review in 1809. He was the eldest son of John Frere of Roydon Hall, Norfolk, and was educated at Eton and Caius College, Cambridge, after leaving which he obtained employment in the foreign office. A satirical poem published by him in 1817, entitled Prospectus and Specimen of an Intended National Work, by William and Robert Whistlecraft, followed by another entitled The Monks and the Giants, obtained in their day much popularity. His translations in verse of some of the Comedies of Aristophanes are well known for their remarkable excellence. Mr. Frere was also known as a diplomatist, having entered Parliament in 1796, and succeeded Canning as under-secretary for foreign affairs in 1799. In 1800–4 he acted as British envoy or ambassador at first in Portugal and afterwards in Spain. In 1807 he went to Berlin as envoy and minister-plenipotentiary, and in 1808–9 he was again at Madrid as ambassador at the critical period to which belongs Sir John Moore's retreat on Corunna. The latter part of his life, from 1820, was spent in Malta, where he died on 7th January, 1846. In 1872 his works were published with a memoir by his nephews, W. E. and Sir Bartle Frere. See also John Hookham Frere and his Friends, by Gabrielle Festing (1899).

FRÉRON, ÉLIE CATHARINE, French writer, born at Quimper in 1719, received his education from the Jesuits, and taught for some time in the college of Louis le Grand. He published a journal at first entitled Lettres sur quelques Écrits de ce Temps, and later called Année Littéraire, in which he attacked Voltaire and his school. He died at Paris in 1776.

FRESCO, a term of art applied, originally by the Italian artists, to pictures executed in water-colours upon a freshly-plastered wall. Mineral or earthy pigments are employed which resist the chemical action of lime, and in drying the colours become permanent. On the revival of the arts in Europe it became customary to decorate the walls of churches, palaces, cloisters, and convents with fresco paintings. There are peculiarities in the Italian method which we shall describe. The size of the wall to be decorated

being ascertained by accurate measurement, a finished drawing on paper, called a cartoon, was first made, to serve as a model. The artist then had a certain portion of the wall covered over with a fine sort of plaster or Roman cement, of the thickness of an inch or more, and upon this portion he traced off from his cartoon enough to fill the space. But as it was necessary to the success and permanency of his work that the colours should be applied while the plaster was yet damp, no more cement was applied at one time than what the artist could finish with convenience in one day. The first part of his operation after the tracing was to lay in the masses of colour with a large brush, and then to finish up the parts by delicately hatching them over with a series of minute strokes by means of smaller brushes.

In old writers on fresco painting different processes are described for mixing up and preparing the colours, but they all agree in stating that the colours should all be native earths or minerals, as lakes and vegetable colours will not stand, and that the whites made use of should be of white chalk or powdered marble. Secondly, that the vehicle should be a solution of animal glue, prepared by boiling the skins of animals or fishes, such as parings of parchment, glove-leather, &c., or from the whites of eggs. One old author, indeed, directs that a certain number of fresh eggs, yolks, shells, &c., should be well beaten up and pounded in a marble mortar, and that a small portion of good vinegar (say a gill to six eggs) should be added, and the whole mixture beat up with a bunch of fresh twigs cut from a fig-tree. In this way the white and yolks of the eggs form a sort of emulsion, and the vinegar dissolving the earthy matter of the shells renders the vehicle more binding; the yellowness of the eggs would not materially alter the colours, neither would the whites be tarnished thereby, being of chalk, which would not be the case if white-lead or ceruse were employed. As to the fig-leaves, it is well known that the juice given out by them is a species of india-rubber or caoutchouc—an elastic gum which will render the colours less liable to crack. In this manner all the finest fresco paintings of the churches in Italy have been executed. The Sistine Chapel, Vatican, Grotto Ferrato, Farnesine Palace, &c.

The art is very ancient and widely spread, frescoes of early date being found in India, Egypt, Mexico, &c., as also in Pompeii and other places. The example of Michael Angelo and Raphael shows how worthy it is of the greatest artists. The painter cannot seduce the senses by soft tints and tender harmony of colours; he is, therefore, reduced to depend solely on form, character, expression. If oil-painting is better suited for nice expressions of the slightest emotions of the heart, fresco painting is the field which the true poet-painter will prefer. What can be more sublime than the Last Judgment of Michael Angelo in the Capella Sistina! How rich and vast are Raphael's conceptions in the *stanze* and *loggie!* Germany has produced the most distinguished fresco painters in modern times, and Cornelius has established his fame by his grand fresco pictures in the Glyptotheca in Munich. Schnorr is also distinguished in this line, and the Villa Massimi, near Rome, is a fine monument of contemporary German art, as Overbeck, Schnorr, and Feith painted the three rooms in fresco. Fresco painting was long disregarded, when all noble and grand conceptions seemed to have fled from the art; and it is only in recent times that it has been taken up again, chiefly by the Germans. Several works of this kind have been executed in the British Houses of Parliament.

FRESNILLO, a city, Mexico, state of, and 30 miles N.N.W. Zacatecas. It has a spacious square, with a costly fountain in the centre, and contains several large and showy churches. In its vicinity are the celebrated mines of Fresnillo, reckoned among the most productive in Mexico. Pop. 13,000.

FRETS, certain short pieces of wire fixed on the finger-board of guitars, &c., at right angles to the strings, and which, as the strings are brought into contact with them by the pressure of the fingers, serve to vary and determine the pitch of the tones. The frets are so arranged that each stopping of the strings towards the bridge raises the sound a semitone. Formerly, these frets or stops consisted of strings tied round the neck of the instrument.

FREUDENSTADT, a town of Würtemberg, on the right bank of the Murg, 40 miles S.W. Stuttgart. It was once fortified, and has still some remains of fortification; is tolerably well built, contains a large square adorned with arcades, a fine old church, and town-house; and has manufactures of linen, nails, chemical products, vinegar, rosin, and turpentine; and a trade in wood and cattle, sent chiefly to Strasburg. Pop of town (1900), 7076.

FREYA. See NORTHERN MYTHOLOGY.

FREYBERG. See FREIBERG.

FREYBURG. See FREIBURG.

FRIAR (French *frère*, Latin *frater*, brother), a brother or member of any religious order; but more exclusively applied to those of the mendicant orders; of which the four chief were the Dominicans (Black Friars), Franciscans (Gray), Carmelites (White), and Augustines.

FRIBOURG, a canton of Switzerland, surrounded by the cantons of Berne and Vaud, except a narrow part, which touches the Lake of Neufchâtel. The north-west part of the country is more level than the rest, and produces abundance of corn and fruit; the other parts are mountainous, but contain good pastures, which feed great herds of cattle. The chief exports are cattle, butter, and particularly the excellent cheese known by the name of Gruyère. Area, 644 square miles; pop. in 1897, 123,618, of whom the great majority are Roman Catholics.

FRIBOURG, or FREIBURG (called *Freiburg im Uechtlande*), a town in Switzerland, capital of the above canton, picturesquely situated on the Saane, which is here crossed by a magnificent suspension bridge, 905 feet long, 17 miles S.W. Berne. Part of it is built on an elevated rock, part of it in the deep valley of the river, and part on a small plateau. The streets are irregular, steep, clean, and tolerably wide; the houses are mostly well built. It is partly surrounded with walls and towers, and among the chief buildings are the Church of St. Nicholas, a handsome Gothic structure, with a spire 240 feet high, and one of the finest organs in Europe; a town-house with a lime-tree near it, which was planted in 1476, on the day of the battle of Morat (Murten), the cantonal university, founded in 1889, and a Jesuit college. A gorge close to the town is crossed by a second suspension bridge, 689 feet in length and 317 feet high. Pop. (1899), 16,710.

FRICTION, in natural philosophy, the resistance to sliding experienced when any two solids are rubbed together. Molecular friction is recognized in fluids, but it goes by the name of *viscosity*, and is not considered here. When any two solids are rubbed together a certain amount of resistance is experienced, however carefully the surfaces in contact have been smoothed and polished. The smoothest surface that art or nature can produce must still be regarded as being made up of minute heights and hollows, which, when two such surfaces are put together, are able to press against each other in a direction tangential to the surface of the solid, and to give rise to frictional resistance. Friction always acts as a force preventing

motion, or retarding it. It can never, it is plain, produce motion. When friction prevents motion, as when a block of iron or wood rests by friction on an inclined plane without sliding down, it is called *static friction*; when it acts so as to retard a body in motion, it is called *kinetic friction*. The laws of friction have been investigated by several experimenters, among whom were Coulomb, and more recently General Morin.

It is found by experiment that, for any pair of rubbing bodies with their surfaces in a given condition, the friction between them is simply proportional to the force with which the surfaces are pressed together. It is found also to be independent of the extent of the surfaces within certain limits: and, when the body is in motion, it is found to be independent of the velocity of the motion. There is, however, a very great difference between static and kinetic friction. It is, in fact, a matter of daily observation that the amount of force required to set a body in motion when at rest is much greater than that which is required to keep it moving when it is in motion. It is found also that when two solids have been left in contact for a considerable time, the force required to set one of the surfaces in motion over the other is much greater than the force required when they have been touching but a short time. In what has been stated it must be understood that the force with which the surfaces are pressed together is not so great as to distort the surfaces permanently.

It has been mentioned above that the friction is proportional to the pressure between the surfaces in contact. As an example, if a flat steel plate be laid on a smooth horizontal board, and if the weight of the steel plate be 5 lbs., a force of 1 lb., applied horizontally will be found just able to move it. If the steel plate be loaded up so as to make the pressure 10 lbs., a horizontal force of 2 lbs. will just move it; and so on. Whatever is the pressure, one-fifth of it is the horizontal force required to move the body. Numbers have been determined for various pairs of substances, such that if the normal pressure between any two of them is multiplied by the number that corresponds to the pair, the tangential force will be found. Such a number is called the *coefficient of friction* for the pair of substances in question. Tables of coefficients of friction will be found in all books on engineering and mechanics.

It is worth considering how great a part friction performs in nature and in art. If it were not for friction mountains could not stand, except in so far as they might be composed of rigid rocks. It is the internal friction of water and air that reduces the velocity of a torrent or a hurricane, gradually distributing the energy of the motion of particles. It is on account of friction that we are able to twist fibres together to make ropes or threads, and thus to form the various textures that we use for our clothes and for other purposes. Friction is also employed in all the various branches of mechanics.

FRIDAY, with the Anglo-Saxons, *Frigedæg*, has its name from the wife of Odin, Friga. See NORTHERN MYTHOLOGY.

FRIDAY, GOOD, the day of our Saviour's crucifixion, being the Friday before Easter. In most branches of the Christian church Good Friday is celebrated as a day of peculiar solemnity. In England and Ireland it is a general holiday, in Scotland a bank holiday. See HOLY WEEK.

FRIEDLAND, the name of several places in Germany and Austria.—1. A town and lordship in Bohemia, in the circle of Bunzlau, with a castle. Wallenstein bought the lordship in 1622, and was created in the same year Duke of Friedland by the emperor. The town contains (1900) 6229 inhabitants.—2. A small town of East Prussia, in the government of and 28 miles S.E. of Königsberg, on the river Alle. The Russians under Benningsen were here defeated on the 14th June, 1807, by the French under Napoleon. Pop. (1895), 2701.—3. A town of Mecklenburg-Strelitz, on the Mühlenteich, 30 miles N.E. of Strelitz. It has manufactures of linen and woollen cloth and copper ware; tile-works, lime-kilns, &c. Pop. (1900), 7142.

FRIENDLY (or TONGA) ISLANDS, a cluster in the South Pacific Ocean, between lat. 18° and 23° S.; and lon. 173° and 176° W. They consist of three groups, which are divided from each other by two narrow channels, and number altogether about 150, with a collective area of about 400 square miles. The largest island is Tongatabu in the south group, with an area of 128 square miles, and containing the capital Nukualofa. Vavao, in the north group, which is named after it, is next Tongatabu in size; the centre group is called Hapai. The climate is humid and the heat oppressive. The natives are now Christians, and have a number of schools. Their houses are built on posts, and thatched; and the missionaries have introduced glass windows, doors, and wooden floors. The islands are nearly all volcanic, with coral reefs and rocks about them. During an earthquake and volcanic eruption in 1885, a new island, 2 miles in circumference, suddenly appeared. These islands were discovered in 1643 by Tasman, but received their collective name from Cook. Cocoanut oil is almost the only article of export of consideration. The population of the islands is now estimated at about 20,000. They are governed by a native Christian prince.

FRIENDLY SOCIETIES, societies formed for the mutual advantage of the members, and based on the principle that it is by the contribution of the savings of many persons to one common fund that the most effectual provision can be made for casualties affecting, or liable to affect, all the contributors. Mutual provident associations, taking the friendly society form, may be grouped under five main heads:—(1) Affiliated Societies; (2) Ordinary Societies, subdivided into (*a*) Centralized or General Societies; (*b*) Peculiar Trade and Profession Societies; (*c*) Local, including Dividing, Clubs; (*d*) Societies of Females; (3) Collecting Societies; (4) Medical Societies; and (5) Other Societies Registered under the Friendly Societies' Act, such as benevolent societies, working men's clubs, specially authorized societies, and cattle insurance societies. Divisions (1) and (2) offer a sickness as well as a funeral benefit to their members, and some of them offer a deferred annuity or superannuation as an optional benefit in addition. The following figures may be taken as giving the approximate number of members and extent of funds of such societies on 31st December, 1898:—

	Members.	Funds.
(1) Affiliated Societies,	2,555,736	£18,506,188
(2) Ordinary Societies,	2,725,533	13,170,214
(3) Collecting Societies,	5,555,827	4,832,573
(4) Medical Societies,	293,477	66,278
(5) Other Societies,	294,237	1,340,454
Total,	11,424,810	£37,917,702

Mutual provident association on the voluntary principle and in a friendly society form, as an economic duty, is at present characteristic mainly of the English-speaking races. Provident insurance, indeed, is enforced throughout the German Empire among all classes of workmen, but only as a form of state socialism enacted by law and largely subsidized by the state and by the employers.

The affiliated societies (or orders, as they are called) extend their operations beyond the confines of the

United Kingdom to America and the British colonies and dependencies. These societies are fraternities or brotherhoods, occupying in part the position of the old craft guilds. The Ancient Order of Foresters and the Independent Order of Oddfellows (Manchester Unity) far outstrip all the other orders in numerical and financial strength, the former possessing a membership of 912,000, and its branches, termed courts, possess in the aggregate an accumulated capital of £6,600,000, the latter 950,000 members, and in its branches, termed lodges, aggregate funds to the sum of £10,000,000. The amount of relief work done by these societies may be estimated from the fact that during the past fourteen years the lodges of the Manchester Unity have disbursed in sickness and funeral benefits to their members no less a sum than £10,771,000, and in the same period three millions has been added to their aggregate capital. The Loyal Order of Ancient Shepherds (Ashton Unity) is another powerful fraternity, being particularly strong in Scotland; other orders are known as Druids, Rechabites, Free-gardeners, Sons of Temperance, Romans, Locomotive Steam Enginemen and Firemen's Friendly Society, &c. The Independent Order of Rechabites and the Order of Sons of Temperance exhibit the economic phase of the temperance movement, and the former especially has increased very rapidly in recent years. The Locomotive Steam Enginemen, &c., is confined to railway employés, and is the only peculiar trade society which is constituted as an order. It has lately experienced a large secession. In this group, as a rule, the constitution and government are purely democratic, consisting of individual branches (called lodges, courts, tents, senates, &c.), local gatherings of branches (generally called districts), and a central executive elected from annual or biennial parliaments of branch delegates.

The general group consists of bodies with one central office and a scattered area of membership up and down the country, as the Hearts of Oak, the Rational Sick and Burial Association, and the United Patriots; or of bodies known as county societies, because the membership of each society is restricted to the geographical area of some one county—generally of the E. and S. of England. The Hearts of Oak is the giant among its fellows, having 230,000 members and £2,000,000 capital. The funds are all centralized and not retained in districts and lodges (or courts), as is the case with the orders.

Among the societies connected with peculiar trades the most important are those connected with mining. These are accident insurance organizations, the funds of which are subsidized by the employers as a contribution towards their liabilities in the case of fatal or non-fatal casualties to the workmen in their employ. By means of them the workmen have largely contracted themselves out of the Employers' Liability Act of 1880, and the Workmen's Compensation Act, 1897. Membership is almost entirely confined to the coal-getting miners.

Local benefit clubs have had their day, and are being everywhere displaced by branches of the larger of the affiliated orders, as affording superior benefits and greater security. A large proportion of this division consists of what are termed tontine or dividing societies; *i.e.* temporary combinations on the mutual basis, which break up and divide their capital every twelvemonth or so, and then re-form and commence anew. There is here no foresight—no provision made for advancing years of life.

While all the foregoing provide, more or less, a sickness benefit to members, the collecting burial societies restrict themselves to insuring for a funeral benefit. The larger members of the group have nearly swallowed up the smaller, and in Britain there are four societies of over 100,000 members, which comprise between them over 90 per cent of the members and over 88 per cent of the funds. These clubs are: Royal Liver, Liverpool Victoria Legal, Royal London, and Scottish Legal, the membership of the first two exceeding a million each. More than one half, however, of gross membership is made up of children and non-adults. They are trading concerns chiefly for the benefit of the promoters and collectors, these latter calling from door to door for the weekly pence of the members. There is only a technical difference between them and the industrial insurance companies. The contrast in the amount of funds between these clubs and the affiliated societies is as striking as it is suggestive.

Societies of females occupy but a very small position in the great voluntary thrift army—a matter the more to be regretted since the number of girls and women workers in the United Kingdom is over four millions. Separate societies used formerly to be established consisting wholly of juveniles, that is, children between the ages of 3 and 21 years, in connection with societies of the general group and branches of the affiliated orders, but in 1895 the necessity for such separate societies was done away with by an enactment that every society may have members of any age exceeding one year. Altogether the number of different bodies of one class or another registered as separate societies or branches, in Great Britain and Ireland, is nearly 30,000.

Though friendly societies exist mainly for the benefit of the 'masses' the friendly society form of mutual insurance is that under which some flourishing assurance societies, such as the Clergy Mutual, the National Provident, and the United Kingdom Temperance, were originally established; and we may instance as more recent examples of its adaptation to the 'classes', the establishment in London of a society of the general type for the benefit of the medical profession, the Medical Sickness and Annuity Friendly Society; and the Clergy Friendly Society, restricted to members of the Church of England.

Registration under the Friendly Societies Act, 1896, confers many rights making for good government, but does not carry with it financial security. Members receive annual returns, and every five years the financial condition of societies is inquired into and a report made by a valuer, which should be hung up in a conspicuous place at the registered office. The funds are guarded against maladministration or fraud, and facilities for prosecution of the offender or offenders given. The three prime necessities for securing financial stability and efficient government are: (1) Registration, (2) Valuation, (3) Graduation. This last requisite refers to the adoption of a graduated or sliding scale of annual contribution according to age on joining a society, in place of the old unscientific method of charging a uniform rate for all ages of entry.

Friendly Societies exist also in the colonies and in foreign countries. In the Cape Colony difficulties arise through differences of race, but there are 130 societies with 14,000 members, and nearly £90,000 funds. In the several Australasian colonies, more than £3,000,000 has been accumulated by these societies. In France, a distinction is drawn between societies that are simply authorized and societies that are approved, and these latter enjoy many privileges, which amount to a considerable state subsidy. In Belgium, also, a distinction is made between recognized and not-recognized societies. The former are 756 in number, have 100,000 members and £150,000 capital. In Hol-

land, half the population are insured in some sickness benefit society or other. In Spain, the history of these societies may be traced back to the mediæval guilds. See also BUILDING SOCIETIES, CO-OPERATIVE SOCIETIES.

FRIENDS. See QUAKERS.

FRIESLAND, a province in the Netherlands, bounded partly by the German Ocean and the Zuyder Zee. It is generally flat, and parts of it are below sea-level, being protected by dykes. It is well watered, has numerous small lakes, and is intersected by many streams and canals, the latter affording a complete system of communication. Four-fifths of the province are under cultivation, the usual cereals being grown on the suitable soil. Excellent horses, the best in Holland, cattle, and sheep are reared, and cattle and other agricultural produce are sent to England. It is sometimes called West Friesland, to distinguish it from East Friesland, now the district of Aurich in Hanover. It is divided into three districts — Leeuwarden, containing the capital of same name, Sneek, and Heerenveen. Area, 1281 sq. miles. Pop. (1897), 340,512. See FRISIANS.

FRIEZE, a kind of coarse woollen stuff or cloth, with a nap on one side. Much cloth of this kind is made in Ireland.

FRIEZE, in architecture, that part of an entablature between the architrave and cornice, often enriched with figures of animals, &c., in relief. See ARCHITECTURE.

FRIGATE, in the navy, formerly the next class of vessel to a ship of the line, being a full-rigged ship with two decks, while a ship of the line had three. Frigates were usually fast sailers, and were employed as cruisers, to convoy merchantmen, &c. These vessels usually mounted from twenty-eight to sixty guns. Since the introduction of armour-clad warvessels the term frigate has been superseded by that of cruiser, but a large full-rigged merchantman is still sometimes so called. The name was in early use in the Mediterranean, and was applied to a long, swift vessel propelled both by oars and sails.

FRIGATE-BIRD, or MAN-OF-WAR BIRD (*Tachypetes aquilus*), a tropical web-footed bird of the family Pelecanidæ. The colour of the adult bird is shining black, glossed with green, the female being dull black above, and white, streaked with cinnamon, upon the head, breast, and under parts. Including the long tail the male bird reaches 3 feet in length, but the body is extremely small. The bill is longer than the head, strong, hooked at the point, and sharp. In proportion to their size their wings are longer than in any other bird, having an extent of 7 feet or more. Their flight is so powerful that they are seen more than a thousand miles from shore. They move with great difficulty on land, and rarely alight on the water. They do not dive in search of food, but obtain it on the wing, the flying-fish being a frequent prey. Possessing great strength and superior power of wing, the frigate-bird pursues the terns or gulls which have secured a fish, and by beating them with wings and beak forces them to drop or disgorge it: then descending with great rapidity, it seizes the prey before it reaches the water. Its usual locality for breeding is the summit of some rocky cliff; on the rock there is no nest, but when the bird breeds among trees where there are no rocky shores, it makes a rough scaffolding of sticks like the nest of the wood-pigeon. There is only one egg, of a chalky whiteness, and while sitting the bird is very bold and will not move, even if pushed with a stick. The voice of the frigate-bird is rough and harsh.

FRINGE-TREE (*Chionanthus Virginica*) is a small tree belonging to the same natural family with the olive, inhabiting America from lat. 39° to the Gulf of Mexico. It sometimes attains the height of 20 feet, but usually does not exceed 8 or 10 feet; the leaves are opposite, oval, and 6 or 7 inches long; the flowers are very numerous, snow-white, disposed in panicled racemes; the corolla is divided into four long linear segments, whence it derives the name of *fringe-tree*. The fruit is an oval drupe, containing a single striated nut. This tree is frequently cultivated in gardens as an ornamental plant. Four other species of *Chionanthus* are known, two of which inhabit the West Indies, the third Ceylon, and the fourth Australia.

FRISCHES-HAFF, an extensive lagoon on the Baltic coast of Prussia. It is separated from the Gulf of Danzig by a long and narrow line of low gravel and sand banks (Frische Nehrung), and communicates with it by a narrow strait (Pillauer Tief), on the north side of which is the town of Pillau. Its length is 55 miles; average breadth not over 8 miles. It receives numerous streams, including the Pregel, the Passarge, and the Nogat arm of the Vistula.

FRISIANS, a German tribe, who, about the beginning of the Christian era, occupied the territory between the mouths of the Rhine and the Ems, in the modern provinces of Groningen and Friesland. They became tributaries of Rome under Drusus, and lived for some time on friendly terms with their conquerors, but were driven to hostilities by oppression. They were partially subdued in 47 A.D., and rebelled again with the Batavians under Civilis. In the fifth century a host of Frisians joined the Angles and Saxons in invading Britain. About the end of the seventh century the Frisians in the south-west were subdued by the Franks under Pépin d'Héristal, who compelled them to accept Christianity. A century later the eastern branch of the tribe was conquered and Christianized by Charlemagne. Their country was divided into three districts, two of which were annexed on the division of the Carlovingian Empire to the possessions of Louis the German, and the other to those of Charles the Bald. The latter part was called West Frisia (W. Friesland), and the two former East Frisia (E. Friesland). The distinctive national features of the people were gradually lost by continual contact with their neighbours, and their modern history is chiefly connected with Holland and Hanover.

The *Frisian Language* holds in some respects an intermediate position between Anglo-Saxon and Old Norse. Of all the Teutonic dialects it is the most nearly related to English. Its ancient form exists only in some remarkable collections of laws, of which each *Gau* or district had its own set written in its own language. The *Asegabuch* (dating from 1200) was a series of laws valid for all Friesland. An almost complete collection of those laws is to be found in Richthofen's Friesische Rechtsquellen. Among the few specimens of Frisian literature are, Waatze Gribberts Brilloft, a comedy (1712); It Libben fen Aagtje Ysbrants, a novel (1779); the writings of Japicx, Althuysen, the brothers Halbertsma, Dijkstra, and others. The modern Frisian is mostly confined to the peasantry. It is broken up into various dialects, each of which is more or less unintelligible beyond the narrow district in which it is spoken. Consult Grimm's Deutsche Grammatik; the Altfries. Wörterbuch of Richthofen; Doornkaat Koolman's Wörterbuch der Ostfriesischen Sprache; Paul's Grundriss der germanischen Philologie; Van Helten's Altostfriesische Grammatik; Hewett's Frisian Language and Literature; &c.

FRIT. If the mixture of sand, alkali, and metallic oxides which form the materials for glass-making be heated up at once to a high temperature, instead of the mixture fusing as a whole, the alkali may alone

become fluid, and the other ingredients may remain almost unacted on. To prevent this, and also to get rid of the carbonic acid and water which are apt to cause frothing, the mixture is heated just enough to keep it in a pasty condition, the materials are well incorporated by stirring, and then after combination has taken place, the semifused mass constitutes *frit*. To convert it into glass it must be completely melted, which is effected by heating to a much higher temperature.

FRITILLARIA (*Fritillary*) is a genus of plants belonging to the natural order Liliaceæ. The species are herbaceous; the leaves simple, alternate, though sometimes appearing opposite or verticillate; the flowers terminal and pendent; the perianth campanulate, of six petals; the stamens six; the style trifid. About a dozen species are known, several of which are cultivated in gardens, being hardy and highly ornamental plants. The *F. imperialis*, or crown imperial, so generally a favourite, and supposed to be a native of Persia, differs from the other species in having its large orange or yellow flowers nodding beneath a terminal tuft of leaves.

FRITILLARY, the popular name given to several species of British butterflies. The *Argynnis paphia* is the silver-washed fritillary; the *A. aglaia* is the dark-green fritillary; the rare and much-prized *A. lattonia* is the Queen of Spain fritillary. The name is derived from the colouring of the wings of some of the species being suggestive of the colours of the flowers of the fritillary (*Fritillaria meleagris*).

FRIULI, a formerly independent duchy, consisting, in its widest extent, of the modern Italian province of Udine, the Austrian county of Görz and Gradiska, and the circle of Idria. It was one of the most important duchies of the Longobard Kingdom, and after the overthrow of that monarchy by Charlemagne, and even up to the fifteenth century, when it was conquered by Venice and its territories dismembered, it retained a considerable degree of independence. The inhabitants, called Furlani, are Italian for the most part, but speak a peculiar dialect, into which a strong Celtic element has been introduced. The district is mountainous towards the north, but gradually slopes down into an extensive plain, which, as it approaches the sea, becomes so flat as to form extensive marshes. The soil of the plain is in some parts remarkably fertile, and the minerals include iron and copper.

FROBISHER, Sir Martin, an eminent navigator, was born near Doncaster, in Yorkshire. He was brought up to the sea, and acquiring great skill in navigation the discovery of a north-west passage to the Indies excited his ambition, and after many fruitless attempts to induce merchants to favour his project he was enabled, by the ministers and courtiers of Queen Elizabeth, to fit out a private adventure, consisting only of two barques of 25 tons burden each, and a pinnace of 10 tons. With these he sailed from Deptford, 8th June, 1576, the queen wishing them Godspeed on their way by shaking her hand at them out of a window. In this enterprise he entered the strait which has ever since been called by his name, and returned to England with some black ore, in which some gold was found. Visions of immense wealth to be found in those northern regions induced Queen Elizabeth to patronize a second voyage, and lend a sloop of the royal navy of 200 tons for the purpose. The delusion was even kept up to a third expedition; but all of them proved fruitless. In 1585 Frobisher accompanied Sir Francis Drake to the West Indies; and at the defeat of the Spanish armada he commanded one of the largest ships in the fleet, and was honoured with knighthood for his services. In the years 1590 and 1592 he commanded squadrons against the Spaniards and took many rich prizes. In 1594 he was sent with four ships of war to the assistance of Henry IV. of France, against the Spaniards and leaguers, when, in an attack on a fort near Brest, he received a wound, of which he died on his return home.

FROG. This familiar animal is the type of the order Anurous Amphibia or Batrachians. The family, Ranidæ, to which it belongs is characterized by having the skin smooth, the hind legs long, and the feet usually completely webbed: teeth are present in the upper jaw and palate, seldom in the lower jaw. The tympanic membrane is situated behind the eyes, and is not concealed. The nostrils are placed at the extremity of the rounded muzzle just above its margin, and open directly into the mouth. When the mouth is filled with air the nostrils are closed, and the animal swallows the bolus of air into the sacculate lungs, there being, in the absence of ribs, no provision for such respiratory movements as take place in the chest of mammals. Frogs are thus air breathers, but they are capable of remaining for a considerable time under water. They swim with great vigour, and on land progress by a series of violent leaps, the long hind limbs being powerful levers. Their food is chiefly insects, which they capture by means of the tongue: this organ is covered with a viscid secretion and is attached in front, its free border being behind; it is rapidly projected from the mouth, the insect adheres to it, and is at once swallowed. The frog does not drink, but its soft skin absorbs fluids rapidly, and thus has a double function both of nutrition and as an aid to respiration. The animal retires in winter to the bottom of ponds, from which clusters of frogs may be drawn buried in mud. This hibernation, which is associated with low vital energy, ends in February; in March the spawn is deposited in masses, to which many individuals contribute, each furnishing many hundred eggs. These gelatinous masses, with black globules scattered through them, soon manifest change, and after a time the young escapes as a tadpole, as an animal with short body, circular suctorial mouth, and long tail, compressed from side to side. Gills project on either side of the head from a cleft which answers in position to the gill opening of fishes. The hind limbs first appear as buds, later the fore limbs project, the gills disappear, the lungs becoming more fully developed; the tail gradually shrinks and disappears, and the animal, which was at first fish-like, then closely resembled a newt (or Urodele Amphibian), finally assumes the adult or anourous form. This is a true process of metamorphosis as complete as that of the butterfly; since there is a change not merely of form and proportion, but also of internal organs. The frog is highest among Amphibia, and the successive stages of its development resemble each the adult form of a lower group of animals: but there has been no passage of one form into another, they have rather descended from common ancestors, and the fish and newt have each reached a stage beyond which the frog has become developed. The common frog (*Rana temporaria*, pl. Batrachians, fig. 3) is found in all the temperate regions of the Old World; it is most active after rain, when, squatted in the moist grass, its abdomen rapidly absorbs water. The croak of frogs is a well known sound, which is entirely produced by the larynx, its resonance being increased in the edible frog by cheek pouches. This last-named species, the edible or green frog (*R. esculenta*) is a favourite article of food in Europe. In America, where it is unknown, the large bull-frog (*R. mugiens*) takes its place; this species is of considerable size and even takes small birds as food. Among allied genera are the tree-frog (fig. 2, *Hyla*

arborea, the European tree-frog), which is enabled to live on trees by possessing sucking disks at the extremity of its toes covered with a viscid secretion; the egg-carrying frog (*Alytes obstetricans*, fig. 5), the male of which carries the eggs till the embryo is so far developed; the fire-bellied frog of Europe (*Bombinator igneus*, fig. 6), known by its bell-like cry; the horned frog (*Ceratophrys*, fig. 8) of Brazil; the cuirassed frog (*Hemiphractus*) of South America, which has the skin very dense over the enormous head. Frogs, themselves useful in clearing gardens of slugs and insects, are in turn the prey of birds, especially herons and aquatic birds, of serpents, and fish, the latter destroying large quantities of the spawn. Though exposed to droughts, they can bury themselves in the moist soil and thus live after the ponds are dried up. Though thus tenacious of life, the stories of frogs being found in stone and in trees are for the most part founded on imperfectly noted facts, though it is possible that a frog may now and then get closed into a cavity for which, after entering, it had grown too large; but an aperture must always be present by which water can get access to them.

FROG-FISH. See ANGLER.

FROHSDORF. See FROSCHDORF.

FROISSART, JEAN, a French poet and historian, was born about 1333 at Valenciennes, being, apparently, the son of a heraldic painter. We know very little of his school-days or youth. At the age of eighteen he fell in love with a rich and beautiful lady of high rank, whom he met one day reading a book of romances. His advances were coldly received, and possibly because of this he went over to England, where he was received with great favour by Philippa of Hainault, wife of Edward III., to whom he bore letters of recommendation from the king of Bohemia and the count of Hainault, Philippa's uncle. About a year later he returned to the Continent to see his mistress, but though he at first met with some favour, something led to an estrangement which proved permanent. After a series of wanderings, during which he visited Avignon and Paris, he returned to the court of England. He presented a book of rhymed chronicles of his own composition to Queen Philippa, and was made one of her secretaries. His patron seems to have suggested to him the advisability of travelling in order to obtain materials for further chronicles, and in consequence he visited Scotland, and was entertained by King David Bruce, William, earl of Douglas, and other leading Scottish earls. On his return he became secretary in London to King John of France, but in 1366 he was again on the Continent. He visited Brussels, where he attended a great gathering of minstrels; Brittany, Nantes, and Bordeaux; and afterwards accompanied the Black Prince to Dax, but he was prevented from going with him into Spain by being sent to England on a mission. During these travels he was steadily collecting materials for his chronicles. He afterwards went with the Duke of Clarence to Italy, when this prince married the daughter of Galeazzo Visconti. While in Italy he visited Milan, Bologna, Venice, and Rome, and when in the last-named city he heard of Queen Philippa's death. After the death of his protectress, Froissart gave up all connection with England, and obtained the patronage of the duke and duchess of Brabant. It was at this time that he obtained the benefice of Lestines. Soon afterwards he entered the service of Guy, count of Blois, who induced him to continue his chronicles. He obtained much information from Robert de Namur, father of Marie de Namur, the lady whom Guy took to wife shortly after Froissart's arrival. He seems to have given up the benefice of Lestines on becoming chaplain to his patron and being appointed canon of Chimay. For some twelve years he lived quietly, engaged in writing his chronicles and some less elaborate works, such as the poem Espinette Amoureuse, containing a pleasant brief account of his early life; the poem Joli Buisson de Jonesce, of a somewhat similar character; and the rhymed romance of Méliador. In 1386 he again began to travel in search of information, and passed some time at Ghent and at his birthplace. Learning of the hospitality of Gaston Phœbus, count of Foix, he resolved to visit him, and accordingly he set out for the south. He travelled from Foix to Orthez, where the count was then staying, in company with a knight, Espaing de Lyon, who had seen much fighting, and described it to him with such vigour that Froissart's story of this journey is the most vivid and delightful part of his work. From Gaston and others at his court Froissart also obtained valuable materials. He next sought the patronage of Robert de Namur, to whom he dedicates his chronicles. His last visit to England followed soon after. He is said to have died in poverty at Chimay in 1400 or 1410, but the year, the place, and the circumstances of his death are all alike uncertain. Froissart's poems are not of great value. His chronicles form, however, a work of permanent value, because of their accurate and impartial account of important events of the fourteenth century, and of the vivid pictures which they contain of the life of an age so strikingly different from our own. They narrate events connected with France, England, Scotland, Spain, Brittany, &c., from 1326 to 1400. One of the best editions is that of Buchon (Paris); much more elaborate is that of Luce, continued by Reynaud (Paris, 1869–97; 10 vols.). The earliest, and in some respects the best, English translation is that of Lord Berners (London, 1525, 2 vols.; edited by G. C. Macaulay, 1895, in the Globe Library), although that by Thomas Johnes (1803–5, subsequently reprinted) is more exact.

FROME, or FROME-SELWOOD, a town of England, in county Somerset, on a slope above the river Frome, here crossed by a bridge of five arches, 19 miles south-east of Bristol. It consists of several old and narrow, with some modern and tolerably spacious streets. Among the chief public buildings are the church of St. John (restored in 1846–66) and other churches; literary institute, with a museum, library, and art school; a blue-coat school, &c. In the market-place are a fine cross and fountain. The staple manufactures are woollen cloths, chiefly broadcloths and kerseymeres. There are also art-metal works, foundries, &c. Previous to 1885 it sent one member to Parliament. Pop. (1901), 11,055.

FRONDE, a French party during the minority of Louis XIV., which opposed the court and Cardinal Mazarin, whom the queen-mother had appointed prime minister, after the decease of Louis XIII. (1648). The despotism of Richelieu seemed to be continued, under the administration of this foreigner, in other forms. The taxes were enormous, and when the parliament refused to register them, several of the members were repeatedly imprisoned, and the higher offices in the state were filled by Italians. This excited not only the people, but even the princes of the blood and many noblemen against Mazarin, who had become immensely rich. At the head of the Fronde stood the Cardinal de Retz (which see), and latterly the Prince Louis Condé. The violence and selfishness of the other leaders, who brought the Spanish troops into the country, prevented the Fronde from accomplishing anything for the general welfare, and its efforts served only to strengthen the royal power. The Fronde existed from 1648 to 1653. See BA-

CHAUMONT, where the origin of the name is explained; also FRANCE, MAZARIN.

FRONTIGNAC, a sweet muscatel wine, made at Frontignan, on the south coast of France (dep. Hérault). There are two kinds, the red and white. Epicures use it with some kinds of fish.

FRONTINUS, SEXTUS JULIUS, a Roman of patrician descent, who flourished in the second half of the first century after Christ. He was thrice consul, and commanded with reputation in Britain, under Vespasian. He was appointed by Nerva to superintend the aqueducts of Rome, and left an extant work on this subject, as well as one dealing with the art of war.

FRONTO, MARCUS CORNELIUS, an orator and teacher of eloquence at Rome in the second century A.D. He was a native of Cirta, a Roman colony in Numidia, and went to Rome during the reign of Hadrian. There he soon acquired great fame as a speaker and teacher of rhetoric, and was in consequence selected as tutor to M. Annius Verus and L. Commodus, afterwards emperors under the names Marcus Aurelius and Lucius Verus. He became a member of the senate, and was a consul in A.D. 143. Till 1814 the only extant writings of Fronto were a worthless tract, De Differentiis Vocabulorum, and some fragments; but in that year Angelo Mai recovered many of Fronto's letters from a palimpsest in the Ambrosian library at Milan. These letters were part of the orator's correspondence with Antoninus Pius, Marcus Aurelius, Lucius Verus, and other distinguished friends, and were published under Mai's editorship at Milan in 1815. In 1823 the same distinguished scholar published a new edition of the letters, containing many others which he had discovered in the Vatican library at Rome. The letters show that Fronto was a man of some learning, but without genius or taste. Naber published a critical edition of the whole in 1867.

FROSCHDORF (called by the French *Frohsdorf*), a village in Lower Austria, on the right bank of the Leitha, about 30 miles from Vienna, and close upon the Hungarian frontier. It is remarkable for its magnificent castle, which has acquired a kind of political importance since 1844, when it came into possession of the Duchess of Angoulême and became the head-quarters of the Bourbon party. After the death of the duchess it became the favourite residence of the late Comte de Chambord, who greatly improved and beautified the interior.

FROSINONE, a town in Italy, near the left bank of the Cosa, 50 miles E.S.E. of Rome. It is poorly built, but is the see of a bishop and residence of a cardinal delegate, and has several churches and convents, and two annual fairs, one of six and the other of twenty days. Good wine is grown in the vicinity. Pop. 8200.

FROST is the name we give to the state of the weather when the temperature is below the freezing-point of water. The intensity of the cold in frost is conveniently indicated by the popular expression so many *degrees of frost*, which means that the temperature of the atmosphere is so many degrees below the point at which the freezing of water commences. Frost is often very destructive to vegetation, owing to the fact that water, which is generally the chief constituent of the juices of plants, expands when freezing, and bursts, and thus destroys, the vesicles of the plant. Frost is not so injurious to plants after dry weather as immediately after rain; even in winter the tender vessels of the plant are more filled with moisture in wet than in dry weather. From the same cause the strongest oaks split in a severe frost. Frost is also dangerous, and sometimes fatal, to men and animals. It appears wholly to destroy the irritability of the bodily frame, and to rob it of its internal heat. A person feels an irresistible inclination to sleep; he yields, though against his will, and while lost in insensibility his limbs begin to stiffen. If a man thus asleep be brought into a warm room, the sudden passage from cold to warmth causes his death; but if he be rubbed in the snow he may recover. The same is the case with regard to the frozen limbs of men and animals, which can only be saved by being gradually thawed, especially in snow. Frost is very injurious to certain kinds of food. All watery fruits are deprived by frost of their pleasant taste and their nourishing properties, and soon grow rotten after being thawed. Even meat, which has been preserved from tainting by being frozen, corrupts soon after thawing. Liquids, as beer, for instance, lose their good taste. Many fluids expand by frost, as water, which expands about one-tenth part, for which reason ice floats in water; but others again contract, as quicksilver, and hence frozen quicksilver sinks in the fluid metal.

The natural history of frosts furnishes very extraordinary results. The trees are often blighted as with the most excessive heat, in consequence of the separation of water from the air, which is therefore very drying. In the great frost in 1683 the trunks of oak, ash, walnut, &c., were very much split and cleft, so that they might be seen through, and the cracks were often attended with dreadful noises, similar to those produced by the explosion of fire-arms.

Hoar-frost is frozen dew. It may either freeze while it is falling, when it is found loosely scattered on the ground; or having deposited in the early part of the night it may freeze during a subsequent part of it, owing to radiation. It is generally seen most profusely in spring and autumn; because at those times, while on clear nights the cold is sufficient to freeze the dew, the days are at the same time sufficiently warm to cause a very considerable quantity of moisture to evaporate into the air. In our article DEW (which see) we referred to the effect of radiation in modifying the deposition of dew on various substances, and the curious phenomena thus frequently exhibited. Similar results are observed in the formation of hoar-frost, some of the more remarkable of which are represented in the plate to the article SNOW. In the case of a wooden railing of the form shown in fig. 43, the hoar-frost was uniformly deposited on the surface of the upper bar, the radiation from which into the surrounding atmosphere, owing to the absence of any intervening obstacle, was completely unchecked. On the lower bar, on the other hand, the frozen watery particles were only deposited on the exposed spaces between the vertical bars, the shelter afforded by which to the surfaces immediately behind them prevented the formation of hoar-frost by checking the radiation. Where, from the increase of temperature, the particles deposited have begun to disappear, the intervention of any object exercises an opposite effect to that just described. Thus, a druggist's window, which in the morning had been uniformly covered with hoar-frost, presented in the course of the day the appearance shown in fig. 44, where the particles opposite the glass vessels in the inside alone remained unmelted, the intervening spaces being clear. The mode in which the crystals of hoar-frost are deposited may be arranged under three heads, viz., where the spherical globules of moisture are frozen without undergoing any change of form; where they assume a spicular or pointed shape; and where they arrange themselves in varied and fanciful forms. Fig. 45 represents the spicular particles of hoar-frost on the chamfered edge of the summit of a wooden post. Figs. 46 and 47 exhibit

the frozen particles on the upper and under sides of fallen autumnal leaves. The third variety of hoar-frost crystals is found on flat surfaces, more especially glass, the resistance presented by which to the process of crystallization, and the effect of its imperfect and irregular conducting power, induce a variety of motions in the condensed vapour immediately previous to being crystallized. Instances of the diversities of form thus assumed by the crystals are given in figs. 48, 49, and 50. Fig. 53 exhibits a pane of glass, the lower part of which is covered with uniform particles of hoar-frost, the upper edge being bounded by numerous fern-like crystals, above which are others resembling leaves. Magnified representations of the latter are given in figs. 51 and 52.

FROUDE, JAMES ANTHONY, English historian and man of letters, was born, April 23, 1818, at Dartington, Devonshire, his father being Archdeacon of Totnes. He was educated at Westminster School, and then at Oriel College, Oxford (1836–40), where he came strongly under the influence of Newman and the high church party. In 1842 he became a fellow of Exeter College, and gained the chancellor's prize for an essay on the Influence of Political Economy on the Moral and Social Welfare of the Nation. He assisted Newman in his work on the Lives of the English Saints, and the life of St. Ninian was from his own pen. In 1844 he took deacon's orders, but his religious views soon underwent a great change in the direction of scepticism, a change which led to the resignation of his fellowship, and to the giving up of the post of head-master of the high school of Hobart Town, Tasmania—an appointment he had just received. In 1848 he published the Nemesis of Faith, a story with a hero whose religious experiences resembled those of Froude himself. He now adopted literature as a profession, and for some years supported himself mainly by contributions to periodicals, such as Fraser's Magazine and the Westminster Review. In 1856 appeared the first two volumes of his great work—the History of England from the Fall of Wolsey to the Defeat of the Spanish Armada—completed in 1869 in twelve volumes. Public attention was at once attracted to this work, as well by the excellence of its style and the narrative power it displayed, as by the originality of the author's views—more especially in regard to the character of Henry VIII., of whom Froude constituted himself the vindicator and apologist. Admiration, however, was mixed with strong hostility, and while some critics stigmatized it as an attempt to glorify tyranny, others pointed out that its statements of fact were not to be depended on. Of the latter class Freeman was the chief, and for years continued to draw attention to Froude's inaccuracies, and to demolish his claims to rank as a trustworthy historian. In 1869 Mr. Froude was elected lord-rector of St. Andrews University, and delivered to the students the usual address. His next historical work, the English in Ireland in the Eighteenth Century, appeared in 1872-74 in three volumes, and met with a similar reception to its predecessor. In 1872 he went and delivered lectures in America, and in 1874 was sent to South Africa on a government mission. Having been appointed Carlyle's literary executor, he edited Carlyle's Reminiscences (two vols. 1881); Letters and Memorials of Jane Welsh Carlyle (that is, Mrs. Carlyle—1883, three vols.); and himself wrote a life of Carlyle in four volumes (1882 and 1884). These works gave rise to much heated discussion, and Froude was very generally blamed for doing Carlyle a disservice by giving to the world matter that a discreet editor would have refrained from publishing. In 1892 he succeeded his old antagonist, Freeman, as professor of modern history at Oxford. Two years later he died, October 20, 1894. Among minor works written by him we may mention: Short Studies on Great Subjects; Cæsar: a Sketch; Oceana, or England and her Colonies (a visit to Australia, &c.); the English in the West Indies (partly the result of personal observations); The Two Chiefs of Dunboy (an Irish romance).

FRUIT. For the structure and technical names applied to various kinds of fruit, see BOTANY. The value of fruits to man, which exceeds that of all other parts of plants, may depend on the farinaceous matter of their seeds, as in corn-plants; on the starchy matter of the pulpy part, as in the banana or bread-fruit; sometimes on fixed oils, as in nuts; or on sugar and acids with gum, pectine, &c., as in numerous succulent fruits. Some fruits are valuable for peculiar medicinal properties, or as yielding condiments or perfumes. Coffee, cocoa, pepper, and many other articles of daily use are obtained from fruits. The abundance of succulent fruits in tropical climates contributes much to the health and comfort of the inhabitants; their temperature when newly pulled, being much below that of the atmosphere, renders them peculiarly grateful. We can only enumerate the principal cultivated succulent fruits, referring the reader for further details to the articles we have devoted to each. The fruits indigenous to Britain, or which have been cultivated to any important extent, are the apple, pear, quince, medlar; the plum, cherry, apricot, peach, and nectarine; the gooseberry, currant (red, white, and black), raspberry, strawberry, mulberry, cranberry, bilberry; the hazel-nut, chestnut, and walnut. The more important of foreign fruits are the fig, date, grape, orange, lime, lemon, citron, banana, cocoa-nut, pine-apple, tamarind, pomegranate, bread-fruit, olive, almond, melon, &c. In 1899 the value of the oranges and lemons imported into the United Kingdom amounted to £2,635,471; of apples and pears, £1,452,494; of grapes, £588,467; of currants, £1,035,905; of raisins, £1,054,136; of nuts, £598,653; of almonds, £514,023; total of all fruit imports, £11,131,013. The area under fruit in Great Britain in 1902 was 312,234 acres.

The conditions necessary for keeping fruit well are a dry atmosphere, a cool steady temperature, and darkness. To ensure these conditions a room in which fruit is to be stored should be in a dry situation, the floor should have a circulation of air below it, and there should be free ventilation, but at the same time the doors and windows ought to fit closely in case of frost. The exhalations from ripe fruit have an injurious effect on that which is late in becoming fit for use; it would be well, therefore, if the early ripening sorts were separated from the late by a close partition. Pears and apples may be kept in close drawers, care being taken to remove any that exhibit the least sign of decay.

Fruit, as regards its chemical composition, consists of carbon, hydrogen, nitrogen, oxygen, and inorganic matter; but the proximate substances formed by these elements, and present in fruits, differ to a considerable extent, while upon them the fruit depends for its colour, taste, odour, and other properties. The ingredients are water, cellulose, sugar, starch (?), gum, acids, nitrogenous, pectous and colouring principles, fixed and essential oils, inorganic matter. The water amounts to between 80 and 90 per cent of the whole fruit; the sugar, of which there are two or three kinds, varies from 1·5 to 15 per cent or even more, some grapes for instance yielding as much as 19 per cent; the acids, chiefly malic and citric, vary from a few hundredths to 4 or 5 per cent, the other ingredients as a general rule being present in small amount. The proportions of the ingredients changes in a marked manner with the ripening of the fruit; thus the green

colour is reduced in quantity or entirely removed, the sugar is developed, and the acid diminished. The pectous substances are those which produce the jellies of the succulent fruits, such as currants, gooseberries, and apples; there are several of these all derived from *pectose*, which in the ripening undergoes various transformations. See PECTOUS SUBSTANCES.

FRUITFULNESS, the power of abundant production. This power exists in some organic beings in an incredible degree: in a poppy 32,000 seeds have been counted; the elm produces annually 100,000 seeds. How numerous is the annual production of seeds from fruit-trees, &c.! As each of these seeds is capable of becoming an individual of the same sort, if each of them grew up the whole surface of the earth would soon be covered with these trees. The microscopic spores of the puff-ball and other fungi are produced in numbers beyond all computation, and are developed with extraordinary rapidity. In the lower classes of animals the fruitfulness is no less great: the queen-bee lays every year 5000 or 6000 eggs. The vast swarms of locusts, which sometimes lay waste immense tracts of cultivated country in Asia and Africa, justify us in attributing to them the greatest fruitfulness. But the most remarkable instance of fertility known is that of the aphides or plant-lice: the *Aphis lanigera* produces each year ten viviparous broods and one which is oviparous; each generation averages 100 individuals; the increase in the tenth generation is 1,000,000,000,000,000,000, or one quintillion. If the oviparous generation be added to this, you will have a thirty-times greater result. (Owen.)

The smallest herring has 10,000 eggs; a carp which weighs only half a pound has 100,000, a larger one 262,280; a perch, 324,640; the spawn of the sturgeon is calculated to contain 7,653,200 eggs; in the cod-fish the number of eggs is reckoned at 9,344,000. In the higher classes of animals there is less of fruitfulness, yet even in men it is greater than the mortality. In the last case, however, much depends upon climate, season, food, habits, manners, temperament, &c.

FRY, ELIZABETH, a distinguished female philanthropist, was the third daughter of John Gurney, Esq., of Earlham Hall, near Norwich, and was born on 21st May, 1780, at Bramerton, in the neighbourhood of that town, where her parents resided during the summer. Her father was a wealthy merchant and banker, and a member of the Society of Friends, but did not conform rigidly to the strict practices of the Quakers. At the age of twelve she lost her mother. During early youth she led rather a gay life, along with her sisters frequenting balls, concerts, and other amusements; but in her eighteenth year a sermon preached by William Savery, an American Quaker, at Norwich, had the effect of turning her attention to serious things, and making her adopt more decided views on religious matters. One of the first-fruits of this change of mind was the setting herself to the instruction of seventy poor children, whom she taught in her father's house at Norwich. About this time also she made the acquaintance of Joseph Fry, an extensive London merchant and a strict Quaker, to whom she was married on 19th August, 1800. She resided with him in London till 1809, when on the death of his father she removed to Plashet House, Essex. The following year she became a preacher among the Friends. Having paid a visit to Newgate in 1813, she was so impressed by the scene of squalor, vice, and misery which she there witnessed, that the amelioration of our prisons and their inmates became with her a fixed object, to the attainment of which all her energies were to be devoted. In 1817 she succeeded in establishing a ladies' committee for the reformation of female prisoners in Newgate, along with a school and manufactory in the prison, the results of which proved eminently satisfactory, introducing order, sobriety, and industry where formerly nothing had prevailed but drunkenness, confusion, and neglect. These improvements were shortly afterwards introduced by her means into other prisons. In the pursuit of her philanthropic labours she made tours through various parts of the United Kingdom, and also visited France, Belgium, Germany, and Holland. She died at Ramsgate on 12th October, 1845.

FUCACEÆ, a family of brown or olive-green algæ, comprising many of the larger sea-weeds. They exhibit a differentiation into a usually flattened and branched shoot, often bearing air-bladders, and an organ of attachment, which performs some of the functions of the roots of higher plants. They are reproduced both sexually and asexually; in the former mode the male and female elements arise in flask-shaped hollows on definite portions of the shoot. The type genus *Fucus* contains about sixteen species, of which *F. vesiculosus* and *F. serratus* are common on British coasts, forming the bulk of the plants known as *wrack*. The species of this genus have ribbon-like shoots branching in one plane, and attached by sucker-like discs to stones and similar objects. Some of the species have a midrib and air-bladders. *Ascophyllum*, *Pelvetia*, *Cystoseira*, *Halidrys*, and other genera are also British, and *Durvillæa* is a Pacific genus. *Sargassum bacciferum* is the gulf-weed of the Sargasso Sea. The family includes more than 300 species.

FUCHSIA, a genus of plants, the type of the tribe Fuchsieæ, natural order Onagraceæ, named after the botanist Leonard Fuchs (1501–66). The genus contains more than fifty known species. They are natives chiefly of South America and of the southern portion of North America, particularly of the Cordilleras of Peru and Chili. Some of them have been found in New Zealand. They are much cultivated in Europe, both in conservatories and in the open air, for the beauty of their flowers. Only a few species are hardy enough to bear a northern climate, but some of them, though killed to the ground by frost, spring again from the root, and flower in autumn. They are propagated with great facility from cuttings, but the berries, which are preserved and eaten in South America, rarely ripen in this country. The varieties are very numerous in their native countries, and the species cultivated here afford ever-increasing varieties. The plants are shrubby or arborescent, sometimes climbers; the flowers are pendant, large, and fine, with brilliant and delicate colouring—violet, rose, and white; the calyx is four-cleft, the corolla four-petalled, the fruit four-celled. The leaves are opposite and verticillated. The flowers are both axillar and terminal, usually one flower springing from the axil, more rarely in racemes at the top of the branches. The fuchsia was introduced into England in 1823.

FUCHSINE. By the action of arsenic acid, stannic chloride, or other oxidizing agents upon a mixture of aniline and its homologue toluidine, a mass with a bronze or coppery lustre is got which, dissolved in water, precipitated with common salt, and the precipitate washed and crystallized from water, forms aniline red, fuchsine, or magenta, and can be used in this form for dyeing, though it is generally dissolved in acetic or hydrochloric acid. The chemical substance from which fuchsine is derived is called rosaniline (which see). Fuchsine has been charged with being poisonous, and yet it has been used for imparting a colour to confectionary, and, it is said, to sausages.

FUCHS'S SOLUBLE GLASS is a silicate of potassium, made by fusing 15 parts quartz sand, 10 of potassic carbonate, and 1 of charcoal. A similar compound is made from 15 parts sand, 8 carbonate of sodium, and 1 of charcoal. The mixture being made, is heated in a crucible until it is liquefied, care being taken that the materials do not remain too long in contact with the crucible, otherwise alumina, &c., may be dissolved, and the product alter its character. After cooling it forms a hard vitreous mass, tolerably permanent in the air, with conchoidal fracture; and varying in colour, passing from pale-green into black. It is soluble in water, with alkaline reaction; the solution is not very stable, being apt to deposit silica on standing, and particularly if carbonic acid gas be absorbed. Soluble glass is employed to render wood uninflammable, and along with a solution of calcium to give stonework a waterproof coating. It is also the fixing agent in the art of *stereochromy*. A strong solution of an alkaline silicate is prepared for use in the arts —for instance, for making cheap soap—by heating silica, in the form of ground flints, with an alkali under pressure. It forms a thick ropy fluid, from which silica deposits on dilution with water. See WATER-GLASS in Supp.

FUCINO, or CELANO (Latin *Fucinus Lacus*), a former lake of Southern Italy, at one time about 11 miles long, 5 miles broad, and 35 miles in circuit, lying among the Apennines, about 2180 feet above sea-level. As the lake had no outlet the water often rose and submerged the neighbouring lands, hence the Emperor Claudius caused a tunnel to be constructed to carry off its surplus waters into the Garigliano. On this vast work 30,000 slaves are said to have laboured eleven years, but it was soon allowed to fall into disrepair. Between 1852 and 1862, however, the tunnel was repaired and enlarged, and the lake has now been thoroughly drained, and 36,000 acres of rich arable land placed under cultivation. The works were latterly carried on at the expense of Prince Torlonia of Rome, and settlers from his estates were planted on the reclaimed land.

FUEL. Fuel may be defined as 'any substance which is used for the production of heat by combustion'. Fuels are all—with the possible exception of natural oil and gas—of vegetable origin, and consist essentially of carbon combined with hydrogen, small quantities of oxygen, and other elements, with a little mineral matter, which is left, as ash, when the fuel is burned. Fuels may be conveniently classified into *natural* and *prepared*. The natural fuels are used in the condition in which they are obtained, or with no greater preparation than drying. The prepared fuels undergo a more or less complex treatment before use. The essential combustible constituents of all fuels are carbon and hydrogen, all others being of less importance, or in some cases deleterious. Oxygen when present diminishes the heating power of a fuel, because, being already combined with some of the combustible elements present, that portion of them is unable to combine with more oxygen that is to burn, and therefore is rendered useless as a fuel. It is generally assumed that the oxygen present is combined with hydrogen in the proportion required to form water, and the hydrogen present over and above the quantity thus combined with the oxygen is called the available hydrogen. The amount of available hydrogen present in a fuel is of far more importance in determining its value than the total amount of hydrogen.

The heating power of a fuel is measured by the number of units of heat which would be evolved by the complete combustion of 1 lb. of the fuel. This is called its *calorific* power, and is indicated by the letters C.P. A British *thermal unit* is the amount of heat required to raise 1 lb. of water at 62° Fahr. one degree Fahrenheit. The C.P. (calorific power) of carbon burning to carbon dioxide is 14,500 B.T.U. (British thermal units), and that of hydrogen burning to water is 61,500 B.T.U.

Wood.—Wood, though at one time the universal fuel, is now very little used, except in regions where other fuels are scarce and carriage is expensive. The essential constituent of wood is cellulose ($C_6H_{10}O_5$), which contains carbon 44·4 per cent, hydrogen 6·17 per cent, oxygen 49·39 per cent; but as the plant grows this is partially converted into lignine, which contains more carbon and less oxygen. Other constituents richer in carbon and oxygen are also stored up, so that an average perfectly dry wood contains about 50 per cent of carbon, 6 per cent hydrogen, 41 per cent of oxygen, with 1 per cent of nitrogen, and 2 per cent of mineral matter or coke. Wood always contains a large quantity of water, the actual amount depending on the age of the tree, the part from which the wood comes, and the season of felling. When a tree is to be used for fuel the bark is removed, and its wood should be left exposed to the air, but protected from the rain for a considerable time. It thus becomes air-dried, but still retains about 20 per cent of water. Wood is not a good fuel: it contains a large quantity of water which has to be evaporated, thus using up heat; and for this reason green or undried wood is rarely used. The C.P. of wood is about 5000 to 6000 B.T.U. Wood is bulky, and therefore occupies much space, but it kindles readily and burns with a long flame.

Peat.—Peat is the more or less decomposed remains of plants, mostly of low types. It occurs in damp situations where the plants grow and die, their remains forming the soil for the next generation. Peat is a poor fuel. It contains a large quantity of water, a small quantity of available hydrogen, the ash is often very high from the presence of intermixed mineral matter, and it falls to pieces when burning. (See PEAT.)

Coal.—Coal as a fuel may be defined as 'a solid stratified mineral substance, black or brown in colour, and of such a nature that it can be economically burned in furnaces and grates' (Percy). There are four chief varieties of coal:

(1) Lignite, (2) Bituminous coal, (3) Anthracite, (4) Cannel coal.

Lignite or Brown Coal.—This coal is of more recent origin than true coal, and approaches much nearer to wood in composition. In some varieties of lignite the woody structure can be distinctly made out (wood-coal), but others are black and pitchy (pitch-coal.) Lignite is a poor fuel, it often contains a large quantity of water, and the available hydrogen is low.

Bituminous Coal.—This includes all the ordinary burning coals. They are so called because they burn with a smoky luminous flame, like the mineral bitumen. They are composed of the remains of plants, in many cases almost entirely of spores. When coal is broken it usually breaks into roughly rectangular fragments, and on the surface, which is parallel to bedding, are to be seen little patches of a soft black material, which soils the fingers readily. This is called 'mother of coal', and is probably the remains of the bark and more durable portions of the vegetable tissue. When coal is heated in a closed vessel, water and various gaseous and liquid products of distillation are given off, and a solid residue or coke is left. The residue may vary in quantity from under 50 to over 90 per cent, and may be a powder or a more or less dense solid mass.

When, on being heated, the coal swells up so that all trace of the original particles is lost, and

the coke is hard and dense, the coal is said to be a *caking coal*; when the particles are only slightly coherent the coal is said to be *non-caking*.

Bituminous coal contains from 75 to 93 per cent of carbon, from 19·5 to 3 per cent of oxygen, and from 5·5 to 4 per cent of hydrogen, with small quantities of nitrogen, sulphur, and other constituents. On being burned, coal leaves a residue of non-combustible matter or ash, which may vary in amount from 2 to 10 per cent. A large percentage of ash seriously reduces the value of a coal. There are several varieties of bituminous coal:

1. *Long-flame non-caking coal* contains about 75 per cent of carbon, and yields from 50 to 60 per cent of a pulverulent or only slightly coherent coke. This kind of coal burns with a long smoky flame. It is very abundant in the Scotch coal-fields, and, owing to its weak coking power, it can be used *raw*, that is, uncoked, in the blast-furnace. The Scotch splint coals belong to this class.

2. *Gas-coal* contains about 80 per cent of carbon and yields about 65 per cent of coke, which is distinctly caked, but the coke is soft and friable, and easily broken. Coals of this class often yield as much as 10,000 cubic feet of gas per ton, and they are therefore largly used for gas-making. They burn with a long, smoky flame.

3. *Furnace Coal.*—This coal contains about 85 per cent of carbon, and yields about 70 per cent of a moderately compact coke. Coals of this class burn with a long flame, and are the best house and furnace coals.

4. *Coking Coal.*—This coal contains about 90 per cent of carbon and yields about 80 per cent of a hard, dense, and compact coke. These coals burn with a shorter flame than the classes already mentioned. They are excellent house and furnace coals, and are largely used for the preparation of coke.

5. *Anthracitic Coal.*—This coal contains about 93 per cent of carbon, and yields on ignition about 90 per cent of a slightly coherent, soft coke. Coals of this class burn with a short flame. They are known as blind-coals, or smokeless steam-coals, and are largely used for steam-raising.

It need hardly be said that no hard-and-fast line can be drawn between the different classes of coal here mentioned, but they pass gradually one into the other.

Anthracite.—This represents a greater degree of mineralization than the bituminous coals. It is hard, dense, does not soil the fingers, and frequently has an iridescent lustre. It contains about 98 per cent of carbon, and leaves on ignition 96 to 98 per cent of residue, which is apparantly quite unchanged. It burns without smoke or flame, and when red-hot is very friable. It ignites only with great difficulty. It is used to some extent as a steam-coal (smokeless steam-coal), and has been used in the blast-furnace.

Cannel Coal.—The coals in this class differ from all others in properties, and probably in mode of formation. They are compact in texture, fine in grain, often break with a conchoidal fracture, and look more like shales than coals. They burn with a very luminous smoky flame—whence the name *cannel*, that is *candle*, coals—and when heated they break up with a crackling sound ('parrot coal'). On distillation they yield a large quantity of highly-luminous gas, and leave a coke which is non-coherent, and contains comparatively little fixed carbon. They are only used for gas-making. All the coals except lignite belong to the Carboniferous period.

Charcoal.—When wood is distilled, about 25 per cent of a black residue, or charcoal, is left. This retains the form and structure of the wood, and contains about 90 per cent carbon. Charcoal burns without flame, except when in large quantity, then carbon monoxide is formed and burns with a blue flame. Carbon monoxide is always among the products of combustion of charcoal, and as this gas is very poisonous, charcoal should never be used as fuel except in fireplaces with a good draught. Charcoal is very light and porous, its specific gravity being about ·2.

Coke.—When a coking coal is distilled, the volatile matters are expelled and a coherent residue of coke is left. Coke is made in ovens of various forms, the most common being the bee-hive oven. Coke made in bee-hive ovens has a steel-gray colour, a metallic lustre, and breaks into more or less prismatic fragments; that made in ovens in which the by-products are recovered is dull black in colour, and breaks into rhomboidal pieces; but for practical purposes there is no difference between them. Coke contains 90 per cent or more of carbon, and is an excellent fuel where heating is to be by contact, as in the blast-furnace, or by radiation, as in domestic fireplaces. When coal is distilled, part of the sulphur present goes into the gas and part remains in the coke, but the coke always contains less sulphur than the coal from which it was made. (See COKE.)

Briquettes.—These are almost always made by mixing powdered coal with hot pitch and pressing the mixture into blocks. They are coming largely into use, especially for domestic purposes.

Waste of Coal.—Coal is the almost universal fuel, and it is so abundant that it is most wastefully used. The ordinary domestic fireplace, for instance, is excessively wasteful. By far the greater proportion of the heat passes up the chimney with the hot gases, the amount actually radiated being very small. When fresh fuel is put on, a considerable proportion of the gaseous and tarry matter escapes combustion and passes up the chimney. Ordinary furnaces are but little less wasteful. The production of smoke also causes great loss, not only by solid carbon carried away, but because smoke results from imperfect combustion. (See WARMING.)

Oils.—Natural oils occur in considerable quantity in some localities, as in Pennsylvania, and are largely used in the immediate neighbourhood for fuel, either as they occur or after fractional distillation, the lighter distillates being used for lighting purposes. The oils used in other districts may be made by distilling oil-shale, blast-furnace tar, &c; the heavier distillates only being used as fuel. The usual method of burning oil is to send it into the furnace in the form of a fine spray by means of a jet of steam or air, this spray being just as combustible as a gas. Oil consists almost entirely of carbon and hydrogen, with only traces of oxygen, and it leaves no ash. Its C.P. is high, often up to 20,000 B.T.U., and, weight for weight, it is therefore better than solid fuel. It is also less bulky, requires fewer stokers to attend to the fires, and the temperature is very easily regulated. Oil fuel has been successfully used for firing steam-boilers, both locomotive and marine, and for other purposes, and it is used direct in oil-engines. Whether oil will ever replace coal as a fuel will be largely a question of cost. For domestic heating and cooking the lighter oils are often burned by means of wick in lamps.

Gaseous Fuel.—Gaseous fuel has several advantages which have led to its very extensive use. *Natural Gas* is evolved from bore-holes in the ground in Pennsylvania and some other places. It consists almost entirely of gaseous hydrocarbons of the paraffin series, and has a high calorific power. *Coal-gas* is obtained by distilling coal in closed retorts. Since a large proportion of the carbon is left

in the form of coke, each ton of coal yielding about 10,000 feet of gas, coal-gas is necessarily too expensive for use as fuel except on a small scale, as for household purposes, for which it is now frequently applied in towns, and for operations where cost is of little importance. The gas contains about 50 per cent of hydrogen, 30 to 40 per cent of hydrocarbons, some carbon monoxide, and small quantities of nitrogen, &c. Its calorific power is about 11,000 to 12,000 B.T.U. *Producer-gas* is gas produced by a special apparatus (the producer) expressly to be used as fuel. When air is blown over an excess of hot charcoal or coke, the carbon is burned to carbon monoxide only, and as this is combustible, a combustible gas is obtained. Such a gas would contain 34·7 per cent of carbon monoxide, and owing to the low heating-power of this gas, and the amount of non-combustible nitrogen present, the C.P. is only about 1500 B.T.U. About one-third of the heat which could be obtained by the combustion of the carbon is evolved in the producer, and is therefore lost, except that it keeps up the temperature of the carbon well above ignition-point. The gas can be much improved by blowing in steam. This, coming in contact with the hot coke, is decomposed, its oxygen combines with the carbon to form carbon monoxide, and its hydrogen is liberated and mixes with the gas. If too much steam be used, the temperature is reduced too much, as steam passes through undecomposed and a good deal of carbon dioxide is formed, which lowers the quality of the gas and causes greater loss of heat. If coal be used in place of coke, the hot current of ascending gas decomposes the coal, and the coal-gas mixing with the producer-gas enriches it. In this way gas can be prepared having a C.P. of about 2500 B.T.U., and with a loss of heat of 15 to 20 per cent in the producer.

The early forms of gas-producer, as introduced by Siemens, were very like large fireplaces. The ash-pits were open, water spray was often thrown on the bars, and the draught was produced by means of a siphon-like cooling-tube. Modern producers are always built quite closed, the mixture of steam and air being blown in by a steam-jet blower. The fuel may rest on fire-bars, beneath which the air and steam is supplied; on the solid bottom of the producer, the air and steam being sent into the midst of the fuel; or the ashes may be allowed to sink into a trough of water, from which they can be drawn without stopping the production of gas. Several producers have been designed in which the removal of ashes is automatic. When coal is used in a gas-producer, tar is given off, mixes with the gas, and is often very troublesome. The tar may be destroyed by passing the gas downwards through the hot coke in the producer; or it may be recovered, together with any ammonia that may be present, by passing the gas through condensing and washing plant.

Water-gas. If steam be blown over red-hot coke, a mixture of carbon monoxide and hydrogen is obtained. This, being unmixed with non-combustible gas, has a high calorific power, and is known as water-gas. As the decomposition of the steam absorbs a large quantity of heat, the gas can only be made intermittently. Air is blown through till the coke is hot, then steam till it is too cool to produce complete decomposition. This gas is used as a fuel to a small extent.

Mond Gas. —Recently Mr. Mond has prepared gas by blowing a very large excess of steam—2½ tons for each ton of coal—mixed with air through a producer. The gas obtained contains over 25 per cent of hydrogen, but owing to the low temperature of the producer the quantity of carbon dioxide is very high. The C.P. of the gas is, however, about 2500 B.T.U. The loss of heat is about 20 per cent, and owing to the large excess of hydrogen, a large proportion of the nitrogen in the fuel passes away as ammonia, about 90 lbs. of sulphate of ammonia being obtained from each ton of coal consumed, against about 20 lbs. in an ordinary producer.

Gaseous fuel has many advantages over solid fuel, the principal being the ease with which it can be distributed to the particular spot where it is required, the readiness with which the temperature of the furnace and the nature of the flame can be regulated, and the fact that it can be heated to a very high temperature before combustion—as in the regenerative furnace—so that a higher temperature can be attained in the furnace than is possible with any other fuel.

FUENTE ('fountain'), with affixes, the name of various places in Spain.—FUENTE-DEL-MAESTRE, a town of Estramadura, province of Badajoz, near the right bank of the Guadajira, 32 miles S.S.E. of Badajoz. Though irregularly, it is for the most part well built, and has still some remains of ancient fortifications, a church of the Corinthian order, an old Jesuits' college, a town-house, Latin and primary schools; manufactures of linen, hardware, and pottery, and a trade in corn, wine, oil, brandy, fruit, and wool. Pop. 6580.

FUENTERRABIA, or FONTARABIA, a small town of Spain, in the Basque province of Guipuzcoa, at the mouth of the Bidassoa, on the French frontier. It was formerly well fortified, but was dismantled by the French in 1794. A conference was held here in 1463 between Louis XI. of France and Henry IV. of Castile. Fuenterrabia was seized by Francis I. in 1521, and recovered by the Spaniards the same year. It was unsuccessfully besieged by the French in 1638, and taken by them in 1719 and 1794. Milton makes Fontarabia, instead of Roncesvalles, the scene of the 'dolorous rout' of Charlemagne, when the brave Roland was slain. Pop. 4000.

FUENTES DE OÑORO, a village of Spain, province of Salamanca, about 16 miles W.S.W. of Ciudad Rodrigo, on the Portuguese frontier, the scene of two engagements fought between Wellington and Masséna on 3rd and 5th May, 1811, during the retreat of the latter from before the lines of Torres Vedras. The battles were bloody and indecisive, the heavier loss being on the side of the French. On the 3rd the French attempted, without success, to take the village of Fuentes de Oñoro, on which the English right rested. On the 5th the French attacked the English line, and gained some strategic advantages, but failed in finally dislodging the English from their position. The object of the battle was to relieve the fortress of Almeida, and its result was the evacuation of that fortress by the French; but Wellington was soon after compelled to retire by the approach of Soult.

FUERO (from the Latin *forum*), a Spanish word signifying jurisdiction, law, privilege, and applied historically to the written charters of particular districts, towns, &c. The term *fuero*, in its historical sense, has a good deal of latitude; it is applied to various written codes; but it signifies generally those laws, privileges, and immunities founded on usage and sanctioned by the suzerain or supreme authority. Fueros are both civil and ecclesiastical. According to the Fuero Real of Alfonso the Wise the law must have the sanction of three things—usage, custom, and the fuero; usage is derived from time, custom from usage, and the fuero from custom. Charles Romey, in his Histoire d'Espagne, defines fueros as particular laws stipulating privileges, immunities, prerogatives, local liberties of a kingdom, duchy, county, town, convent, diplomas or charters granted by the rising powers of Leon,

Navarre, Arragon, Castile, Catalonia, the kings and counts of these countries, according as successive fragments of them were wrested from the Mussulman power. The fueros were therefore the compositions effected by the various towns and districts with the superiors they acknowledged for the preservation of their customs and privileges. These local privileges were sometimes respected even by the Moors, and grew up partly under Moorish domination. There is extant, among others, a charter granted by the Moors in 734 to the town of Coimbre, the authenticity of which is, however, disputed. The earliest of the fueros, as well as the most universal, is the *fuero juzgo*. This name (a corruption of the Latin *forum judicum*) is given to a thirteenth-century translation of a code, attributed to the twenty-third Gothic king of Spain, about the middle of the seventh century. It contains the Gothic laws which, up till this time, gradually superseded the Roman. Each law receives the name of the Gothic sovereign by whom it was promulgated. This code has formed the foundation of Spanish law down even to modern times. It is very complete, containing everything necessary for the government of a kingdom. It was ridiculed by Montesquieu as full of rhetoric and void of sense. Later authorities have formed a higher opinion of it. In spite of all defects Romey says it is the only code of the barbaric epoch which broadly asserts the great principles of morality.

The Fuero Real of Alfonso the Wise, king of Castile and Leon, promulgated in 1255, is said, together with the Partidas, to which it forms a precursor, to be the most complete body of law of the time in Europe. The fueros of Leon, known by the name of *fueros bonos*, were among the earliest of these codes, being about two centuries earlier than the Fuero Real. They contain a complete constitution, civil and ecclesiastical, recognize the rights of self-taxation, and of the nobility of all subjects by birth. The constitution of free towns under these fueros is essentially republican, the king having only a right to name the corregidor, who must be confirmed by the junta of the province, an assembly elected by a very liberal suffrage. The earliest fuero of Castile is signed by Sancho, one of the latest counts of the province (1012–21). The fueros of Castile were confirmed by Don Pedro at the cortes of Valladolid in 1336. The fueros of Navarre were collected under the title El Cartulario del Rey Tibaldo in 1236. The fueros of Biscay were codified in 1371, recast in 1526, and confirmed by Charles V. All the other provinces had their fueros established from time to time as they were emancipated from the Moorish power. As the various monarchies became consolidated, and particularly when they became united under a single head, a different movement commenced. The kings, as their power extended, became anxious to evade or withdraw privileges which interfered with the organization of their kingdom. The privilege of refusing to permit troops raised in one province to enter another was especially irksome to a king of Spain. Charles V. suppressed the fueros of Castile on the pretext of the insurrection of the communeros of Madrid. On the accession of Philip II. Arragon was governed under a viceroy by its own cortes, which consisted of four estates, mitred clergy, first and second class aristocracy (*ricos hombres* and *hidalgos*), and commons. Philip II., who had sworn to maintain the constitution, which prohibited the entry of foreign troops into the kingdom, entered Arragon with an army in 1592, hanged the grand-justiciary, whose office it was to administer the oath, and abolished the constitution. From this time the fueros as a political institution ceased to exist, although some local and municipal privileges continued to be called by that name. In 1833 a civil war broke out in the Basque provinces, in assertion of the fueros, which were only formally recognized in 1844. In 1876, however, the fueros of these northern provinces were superseded by the general laws of the kingdom.

FUERTE VENTURA. See CANARIES.

FUGGER FAMILY, a distinguished family of merchants and bankers of Augsburg. The founder of this family was JOHANN FUGGER, a master-weaver in the village of Grabens, or Goggingen, not far from Augsburg. His eldest son, JOHANN, obtained by marriage the rights of a citizen of Augsburg in 1370. His business prospered, and he engaged in extensive dealings in cotton. He was one of the twelve members of the guild of weavers who sat in the council, and was one of the *Freischöffe* (sheriffs) of the Westphalian *Fem*. He died in 1409. His eldest son, ANDREAS, acquired such great wealth that he was called the *rich Fugger*. His line became extinct in 1583. Johann's second son, JAKOB, carried on an extensive commerce, and was the founder of the still existing line of the Fugger von den Lilien. His numerous sons extended the business, having counting-houses at Augsburg, Nürnberg, and Venice. Three of them, ULRICH, GEORG, and JAKOB, laid the foundation for the greatness of their family. They married ladies of noble families, and were raised to the rank of nobles by the Emperor Maximilian. Ulrich, who dealt in works of art, introduced Albrecht Dürer's works into Italy. To him the family was chiefly indebted for its connection with the house of Austria. Jakob exchanged the cotton goods manufactured at Augsburg for the products of the East Indies, which were diffused over all Germany. On his return from Italy he worked the copper mines of Hungary, and the gold and lead mines of Carinthia and Tyrol. The firm had also mints at Innspruck and Kremnitz, where their gold was coined into imperial money. Jakob became an imperial councillor under Maximilian I. All the brothers were liberal, benevolent, and public-spirited. They built the choir of the Church of St. Ann, Augsburg, the Holzhaus for strangers, and dwellings for the poor in the suburb Jakobi, and they used their influence with the emperor in favour of the liberation of trade from all burdensome restrictions. The Fuggers rendered great services to the house of Austria. They supplied Frederick III. with means for his visit to Burgundy to crown Charles the Bold, and secure the hand of his daughter for his son Maximilian; and Maximilian, who was often in want of money, always found them ready to assist him. For 70,000 gold florins he pledged to them the county of Kirchberg and the lordship of Weissenhorn for ten years, and on eight weeks' notice they raised 170,000 ducats for the Pope Julius II., who, in connection with the Kings of France and Spain, was then assisting the Emperor Maximilian to carry on war against Venice. Jakob built the magnificent castle of Fuggerau, in the Tyrol. He died in 1503.

The family rose to its highest splendour under the Emperor Charles V. Ulrich Fugger's sons had died without heirs; Jakob left no children, and thus all the wealth and dignities of the whole family had fallen to George, who had two sons, RAIMUND and ANTON. When the Emperor Charles V. held the memorable diet of Augsburg (1530) he lived for a year and a day in Anton Fugger's splendid house in the Weinmarkt. Anton had free access to the proud Spaniard, for his family often supplied the deficiencies of the imperial coffers, and the emperor relied much upon their assistance, particularly at the time of his expedition to Tunis (1535). The emperor raised him and his brother Raimund to the dignity of counts and bannerets. He also invested them with the estates of Kirchberg and Weissenhorn, which had been

mortgaged to them, granted them a seat among the counts at the imperial diet, and letters giving them princely privileges. Anton left at his death 6,000,000 gold crowns, besides jewels and other valuable property, and possessions in all parts of Europe and both Indies. The Fuggers did not claim all the privileges of their nobility in Augsburg, as it would have compelled them to renounce their lucrative commerce. They were among the first among the Germans to fit out vessels to take a direct share in East India commerce. Their wealth became such that in 1762 they owned two counties, six lordships, and fifty-seven other estates, besides their houses and lands in and around Augsburg. The highest places of the empire were held by them, and several princely families thought themselves honoured by their alliance. They had collections of rich treasures of art and rare books. Painters and musicians were supported, and the arts and sciences were liberally patronized by them. Their houses and their gardens exhibited the master-pieces of the architecture and taste of those times, and they entertained their guests with regal magnificence. At the Reformation the family took an active part in favour of the Roman church.

Each of the two lines founded by Raimund and Anton has been subdivided into several branches, but they all style themselves *Counts Fugger of Kirchberg and Weissenhorn*. Anton died in September, 1560, leaving three sons, MARCUS, JOHANN, and JAKOB, who became founders of the Nordendorf, Kirchheim, and Wellenberg lines. He left his sons a trading capital of 6,000,000 florins, besides landed property, while Raimund only left 300,000 florins; yet CHRISTOPHER, the son of Raimund, who died unmarried in 1579, was considered the richest of the Fuggers. He created an entailed estate in favour of his brothers and their children. In the sixteenth century the Fuggers formed matrimonial connections with the houses of Hohenzollern, Schwarzenberg, and Oettingen. OTTO HEINRICH FUGGER, in 1618, raised a regiment to assist the Duke of Alba, and fought under Tilly in Franconia and Suabia. He died in 1644, having increased the family possessions by the acquisition of new territories. Towards the close of the eighteenth century the family withdrew altogether from trade, confining themselves to the management of their landed estates. COUNT ANSELM MARIA of Babenhausen, of the Wellenberg line (born 1776, died 1821), was raised by the Emperor Francis II. to the dignity of a prince of the empire. The principality of Babenhausen was annexed to Bavaria in 1806, and LEOPOLD FUGGER BABENHAUSEN (1827–85), grandson of the first prince, was a hereditary imperial councillor, and Lord High-chancellor of Bavaria. He was succeeded by his brother KARL LUDWIG MARIA FUGGER (born in 1829), who in 1891–93 was president of the Bavarian Reichsrat.

FUGUE, a musical term derived from the Latin word *fuga* (a flight), and signifying a composition, either vocal or instrumental, or both, in which one part leads off some succession of notes called the *subject*, which, after being answered by the other parts, is interspersed through the movement at the pleasure of the composer. There are three kinds of fugue—the simple, the double, and the counter fugue. The *simple fugue* contains but one subject. The *double fugue* consists of two subjects, occasionally intermingled, and moving together; and the *counter fugue* is that in which the subjects move in a direction contrary to each other. In all the fugues the parts *fly*, as it were, after each other, whence the name *fugue*. The great masters of the fugal form are Sebastian Bach and Handel.

FUHNEN. See FUNEN.

FULA. See FELLATAH.

FULCRUM, in mechanics, the fixed point about which a lever turns. Levers are divided into three classes, according to the relative positions of the fulcrum, the power, and the weight. These are shown in the plate to the article MECHANICS, figs. 1–9. The pressure on the fulcrum is a matter that requires attention, for the fixed point must be able to bear the pressure. When the forces have parallel lines of action, this pressure is equal to their sum or difference, according as they act in the same direction or not. When the forces are not parallel, the pressure on the fulcrum is found by means of the 'parallelogram of forces'. See also the articles LEVER, MECHANICS.

FULDA, a town of Prussia, in the province of Hessen-Nassau, on the right bank of a river of the same name, here crossed by three bridges, 54 miles S.S.E. Cassel. It is the see of a bishop, and the seat of several courts of law and public offices; contains a cathedral, a handsome modern edifice; several other churches; a castle, once occupied by the prince bishops; a gymnasium (said to be the oldest learned school of Germany, being the direct descendant of a school founded in the eighth century), Benedictine nunnery, ecclesiastical seminary, normal, industrial, and other schools; a library of 70,000 volumes, a savings-bank, infirmary, military barracks, orphan and other hospitals and benevolent endowments. It has important manufactures of cotton, woollen, and linen goods, agricultural machinery wax-candles, sealing-wax, white and ordinary leather, papier-mâché articles, straw chairs, musical instruments, &c.; and an important trade both in the above articles and in corn and cattle. The town originated in connection with a Benedictine abbey founded in the eighth century by St. Boniface. This abbey soon became famous, and in 968 its abbot was made primate of all the German abbeys. Pop. (1895), 14,528; (1900), 16,900.

FULGURITES, the name given to those conglomerations of grains of quartz half-melted together by lightning, and of a cylindrical form, which are sometimes found in rather loose beds or banks of sand. They are generally in a perpendicular position, are sometimes 30 inches in length and 1 or 2 inches in diameter. Their outside is commonly covered with small prickly protuberances, and often also surrounded by a coat of aggregated quartz grains. The inside is frequently lined with a vitreous fusion. They are more or less transparent, owing to the effect of the vitrification. Similar structures are also observed in more compact beds than those of sand, and even in rock masses. They may be met with in many places.

FULHAM, a municipal and parliamentary borough of England, in the county of London, 5¾ miles south-west of St. Paul's, on the left bank of the Thames, opposite to Putney in Surrey, with which it is connected by a handsome stone bridge. It was erected into a parliamentary borough with one member in 1885. Though irregularly built, it has many elegant houses, and derives celebrity from its palace, which, since the time of Henry VII., has been the summer residence of the bishops of London. It stands in a park of about 37 acres, and is merely a brick building of a quadrangular form, without any pretension to architectural effect. The parish church, entirely rebuilt in 1881, has a handsome Gothic tower. Much of the ground in the vicinity used to be laid out in nurseries and market-gardens for the supply of the metropolis, but the whole is now being fast covered with streets. Pop. in 1871, 23,350; in 1881, 42,895; in 1891, 91,639; in 1901, mun. bor., 137,289.

FULLER, ANDREW, an eminent Baptist minister and theological and controversial writer, was born 6th February, 1754, and educated at Soham, Cambridgeshire. In 1770 he became a member of the Baptist church of that place, where he became an occasional preacher, and in 1775 was regularly ordained pastor of the church. In 1782 he accepted the pastoral charge of a Baptist church at Kettering, in Northamptonshire, in which office he continued till his death on 7th May, 1815. He became secretary of the Baptist Missionary Society in 1792. Among his numerous works we may mention The Calvinistic and Socinian Systems Examined and Compared as to their Moral Tendency (1794); The Gospel its own Witness (1799–1800); The Backslider (1801); Expository Discourses on Genesis (1806). A complete edition of his works in five vols. 8vo, with a memoir by his son, Andrew Gunton Fuller, was published in 1831–32.

FULLER, MARGARET. See OSSOLI (MARGARET FULLER).

FULLER, THOMAS, an eminent historian and divine of the Church of England. He was born in 1608 at Aldwinkle, in Northamptonshire, of which parish his father was minister. He was sent to Queen's College, Cambridge, where he graduated B.A. in 1625, M.A. in 1628. In 1630 he took orders and was appointed perpetual curate of St. Benet's parish, Cambridge, and became very popular as a preacher. In 1631 he was collated to a prebend in the cathedral of Salisbury. The same year he published a poem entitled David's hainous Sin, heartie Repentance, and heavie Punishment. He gave up his Cambridge cure in 1633, and next year was appointed rector of Broadwindsor, Dorsetshire His History of the Holy War first appeared in 1639, soon after the publication of which he removed to London, and was chosen lecturer at the Savoy Church in the Strand. He was a member of the convocation which met in 1640, and was one of the select committee appointed to draw up new canons for the better government of the church. About this period he published his Holy State (folio). In 1643 he went to Oxford and joined the king; left in a few months for the army, in which he became chaplain to Sir Ralph Hopton, and employed his leisure in making collections relative to English history and antiquities. At the close of the war he took refuge in Exeter, and was appointed chaplain to the infant Princess Henrietta Maria. In 1646 he was permitted by Sir T. Fairfax to go to London. In 1650 he published a Pisgah Sight of Palestine and the Confines thereof, with the History of the Old and New Testament acted thereon (folio), with maps and views; and in 1650 appeared his Abel Redivivus, consisting of lives of religious reformers, martyrs, divines, &c. In 1655 he published the Church History of Britain, from the Birth of Jesus Christ to the Year 1648; to which was subjoined the History of the University of Cambridge since the Conquest, and the History of Waltham Abbey. In 1658 the living of Cranford, in Middlesex, was bestowed on him, and he removed thither. The Restoration taking place in 1660, he was reinstated in his prebend of Salisbury. His death took place August 16, 1661. The year after his death was published his principal literary work, the Worthies of England (folio)—a production valuable alike for the solid information it affords relative to the provincial history of the country, and for the profusion of biographical anecdote and acute observation on men and manners. The great fault of this, as well as of the former compositions of Dr. Fuller, is an elaborate display of quaint conceit, owing, perhaps, more to the natural disposition of the author than to the taste of the age in which he wrote, when, however, that species of wit was much admired. Among the many marvellous stories told of Fuller's powers of memory, it is said that he could repeat 500 strange and unconnected words after twice hearing them, and recite a sermon *verbatim* after one hearing. See Bailey's Life (1874).

FULLER'S EARTH, a well-known mineral, generally of a greenish white colour, more or less mixed with brown, gray, or yellow; of a soft and friable texture, and somewhat unctuous to the touch. It is a hydrated silicate of aluminium, with oxide of iron, magnesia, and other bases; sp. gr. from 1·7 to 2·4. Before the blowpipe it fuses ultimately to white glass. When thrown into water, it immediately absorbs it, and breaks down into a fine pulp, without becoming pasty. There are very extensive beds of this earth in several counties in England, as Kent, Surrey, Sussex, and at Wavedon, near Woburn in Bedfordshire, and at various places on the Continent. The most important property of this earth, and that which has given it its commercial value, is its power of absorbing oil or grease. Hence its use in removing from woollen fabrics the oil with which the wool has been dressed for weaving. This operation, called *fulling*, is performed in a special mill, and its object is to enable the fibres of the fabric to intertwine with each other, and to make it denser. From its power of absorbing grease the earth is largely employed, several thousand tons of it being obtained yearly from the deposit at Reigate in Surrey. Probably fuller's earth might be used also for domestic purposes, such as scouring wood, and thus form a substitute for soap. A drawback, however, is its insolubility in water, and the consequent difficulty in preventing the earthy particles adhering to the washed surface, and giving it a dingy look.

FULLING, the act of cleansing, scouring, and pressing stuffs, cloths, stockings, &c., to render them stronger, firmer, and closer; called also *milling*, because these cloths are in fact scoured by a *water-mill*. The principal parts of a fulling-mill are the wheel, with its trundle, which gives motion to the tree or spindle, whose teeth communicate that motion to the pestles or stampers, which fall into troughs, wherein the cloth is put, with fuller's earth, to be scoured and thickened by this process of beating it. Fulling has for a number of years past, like most manufacturing processes, become the subject of adaptations of machinery, for the purpose of economizing labour and of improving the finish of the goods. The objects of the process are still, however, the same.

FULMAR PETREL (*Fulmarus glacialis*), a bird of the family Procellariidæ, order Natatores, which inhabits the northern seas, where it is found almost everywhere in incalculable numbers. It breeds in the Faröe Islands, Iceland, Greenland, Spitzbergen, and in Scotland in the Southern Isles of Barra and the Outer Hebrides, and particularlaly in the islands of St. Kilda, Borrera, and Soa. It does not breed in Orkney or Shetland, but occasionally visits the latter in stormy weather. Specimens are frequently found as winter visitors along the coasts of England even to Cornwall, and on the other side of the Channel in Holland, Picardy, and Brittany. The fulmar is about the size of a large duck. The head and neck are pure white; the back and wings of a pearly gray; breast, belly, and under surface white; bill yellow; legs and toes a brownish yellow. The colour of the young is a brownish gray. The bill is large and strong, not so long as the head; the upper mandible is divided by lines or indentations into four parts, and curves suddenly towards the point; the lower mandible is grooved along each side, and the tip curves upwards. The edges of both are sharp and cutting, those of the lower shutting just within those above. The nostrils are inclosed in a tube with a single orifice at the extremity, within which

the division of the nasal openings may be seen. The feet are of moderate size, the tarsi compressed; three toes in front, with slender, curved, and pointed claws, hind toe rudimentary. The wings are rather long. In St. Kilda, where they breed in incredible numbers, these birds are of the greatest value to the inhabitants. Its eggs are held in high estimation, and sought at great risk. It breeds on the faces of the highest precipices, on which every grassy shelf, over a few inches in extent, is covered with their nests. These are slightly excavated in the turf, and lined with dry grass and withered tufts of sea-pink. One egg is deposited at a time, which the natives rob the nest of by descending with ropes from the summit of the cliffs. The birds, both old and young, when seized vomit a quantity of clear amber-coloured oil of a disagreeable odour. This oil is one of the most valuable products of St. Kilda. The old birds have been seen to feed the young with it. The best quality is got from the old birds. The fulmar feeds on animal substances, chiefly fat. It follows whaleships; and its mode of life on the ocean has been described in detail by Captain Scoresby (see Yarrell's British Birds). It flies buoyantly and rapidly, and accompanies the ships to the highest accessible latitudes, keeping an eager watch for any fatty substance thrown overboard. It can fly to windward in the highest storms, and rest composedly on the most tremendous seas. In heavy gales, however, it generally flies low, skimming the surface of the water. It is said sometimes to indicate the position of the whale to the fisher by its motions. When a whale is caught, although few of the fulmars should be present, they fly from all quarters and arrive in thousands as soon as the flensing process (cutting up) is commenced. They follow in the greasy track of the ship, coming within a few yards of the men engaged in cutting, and devour the morsels of fat voraciously and in great quantity. They cannot make much impression on a dead whale till some more powerful animal tears away the skin.

FULMINATION, a term used in chemistry to denote the sudden decomposition of a body by heat or percussion, accompanied by a flash of light and a loud report, and differs therefore but little from *detonation;* except that the latter refers more to the sound, and the former to the flash. The chief fulminating compounds contain gold, silver, and mercury; the latter being manufactured on a considerable scale for making percussion caps. These are salts of a particular acid called fulminic acid (which see). There are other fulminating powders; for example, a small quantity of a mixture of three parts by weight of nitre, two of carbonate of potassium, and one of flowers of sulphur, when heated in a ladle, fuses, and then explodes with a deafening noise, leaving an impression upon the ladle as if it had received a blow downwards. Three parts of chlorate of potassium and one of sulphur, separately reduced to powder, and afterwards intimately mingled, on being triturated in a metal mortar, cause numerous successive detonations, varying in intensity according to the rapidity and force of the pressure employed. Six parts of the chlorate, one of the sulphur, and one of charcoal, detonate by the same means, but more strongly and accompanied by a red flame. All detonating mixtures explode with still greater violence if previously wrapped up in a double paper.

FULMINIC ACID, a peculiar acid, known only in combination with certain bases, and first discovered along with mercury and silver, with which it forms powerfully detonating compounds. The fulminates are readily prepared by dissolving the metal (mercury or silver) in excess of nitric acid, adding alcohol and heating. A complex reaction ensues, in which the alcohol is partly oxidized, the nitric reduced to nitrous acid, which reacts with the alcohol, and among the products is found the metallic fulminate. The mercury salt, first got by Howard in 1800, is a white crystalline powder which explodes by percussion. The silver salt, prepared by Brugnatelli in 1802, forms small white brilliant platy crystals, which, after washing, must be collected in very small quantities on separate pieces of paper, and when dry preserved separately. It is excessively explosive, and detonates with tremendous violence when struck or rubbed. It also explodes when heated, but with care it can be burned without explosion. Fulminic acid does not form salts with the alkalies, but fulminate of silver combines with sodium to form a double salt, and similar compounds are formed by zinc and barium. The analysis of this acid, first executed by Liebig and Gay-Lussac in 1824, leads to the formula $C_2H_2N_2O_2$, so that it is a polymer of cyanic acid; but various views have been advanced as to its constitution and its relation to other substances. By boiling fulminate of mercury with potassic chloride further polymerization takes place, and a new substance called *fulminuric* acid, $C_3H_3N_3O_3$, is the result. The fulminurates are soluble crystalline non-fulminating salts.

FULTON, ROBERT, an American engineer, the introducer of steam navigation on American waters, was born in Little Britain, in Pennsylvania, in 1765. In his infancy he was put to school in Lancaster (Pennsylvania), where he acquired the rudiments of a common English education. His peculiar genius manifested itself at a very early age. In his childhood all his hours of recreation were passed in the shops of mechanics, or in the employment of his pencil. At the age of seventeen years he painted portraits and landscapes in Philadelphia, where he remained till he was about twenty-one. In 1786 he went to England, and was received with great kindness by the American painter West, who took him into his house, where he continued an inmate for several years. After leaving the family of West he appears for some time to have made painting his chief employment. He spent two years in Devonshire, where he formed an acquaintance with the Duke of Bridgewater and with Earl Stanhope. In 1793 we find Mr. Fulton actively engaged in a project to improve inland navigation. In May, 1794, he took a patent for a double inclined plane, to be used for transportation, and which was intended to supersede locks; and in the same year he submitted to the British Society for the Promotion of Arts and Commerce an improvement of his invention on mills for sawing marble, for which he received the thanks of the society and an honorary medal. He also obtained patents for machines for spinning flax and making ropes, and invented a mechanical contrivance for scooping out the earth, in certain situations, to form the channels for canals or aqueducts. He now, and probably for some time previously, professed himself a civil engineer. Under this title he published his work on canals. He derived great advantage from his talent for drawing and painting. He was an elegant and accurate draughtsman.

In 1797 he went to Paris, where he studied the higher mathematics, physics, chemistry, and perspective. While there he projected the first panorama that was exhibited in Paris. He also, after some trials, was successful in introducing a boat propelled by steam upon the Seine. During a visit to Scotland he had seen and obtained drawings of the *Charlotte Dundas*, a steam vessel which had plied with success on the Forth and Clyde Canal. His chief occupation in Paris, however, was the invention of torpedoes for naval warfare, which he offered without success first to the French and afterwards to the British govern-

ment. Napoleon appointed a commission to examine his projects, which, though partially successful, were not found to reach the point of practical utility, and the same decision was come to by the British government in regard to the experiments which he made on the Thames upon the suggestion of Earl Stanhope. He returned to America in 1806. Here he immediately resumed his project of steam navigation, and built a boat of considerable dimensions, which began to navigate the Hudson River in 1807. Its progress through the water was at the rate of 5 miles an hour. February 11, 1809, Fulton took out his first patent for navigation by steam; and February 9, 1811, he obtained a second patent for some improvements in his boats and machinery. In 1811 and 1812 two steamboats were built under his directions as ferry-boats for crossing the Hudson River, and soon after one of the same description for the East River. Of the former Fulton published a description in the American Medical and Philosophical Register for October, 1812. These boats were what are called *twin-boats*—each of them having two complete hulls, united by a deck or bridge; sharp at both ends, and moving equally well with either end foremost; so that they crossed and recrossed without losing any time in turning. He contrived, with great ingenuity, floating docks for the reception of these boats, and a means by which they were brought into them without a shock. Fulton continued his experiments in relation to submarine warfare, and towards the close of his life his patents involved him in protracted lawsuits. He died 24th February, 1815.

FULVIA, the wife of Mark Antony. See ANTONIUS (MARCUS).

FUMAGE, in English law, a tax on every house with a chimney, mentioned in Domesday Book, and commonly called 'smoke-farthings'. It is supposed to have been the origin of the *hearth-money* imposed by Charles II., and repealed by 1 William and Mary, cap. x.

FUMARIACEÆ, a natural order of thalamiflora dicotyledonous plants, having brittle stems with a watery juice; alternate, much-divided leaves; and irregular flowers of two sepals, four petals, and six stamens in two bundles of three. The order is represented in Britain by the two genera *Fumaria* (fumitory) and *Corydalis*. Among the common species of the former are *F. officinalis* and *F. capreolata*, and the latter is chiefly represented by *C. claviculata*; *Dicentra* (*Dielytra*) *spectabilis* is a showy species grown in gardens.

FUMARIC ACID ($C_4H_4O_4$), an acid contained in Iceland-moss, mushrooms, common fumitory (genus *Fumaria*, hence the name), and other plants. From the fumitory it is extracted by digesting with water, straining, and evaporating the fluid to a syrup; from this, when acidified and allowed to stand, the fumaric acid deposits in brown crystals; but, by solution in an alkali, separation from vegetable impurities, and treatment with animal charcoal, the acid is obtained in pure white crystals.

FUMARINE, the alkaloid contained in fumitory. It forms irregular six-sided prisms, and has a bitter taste and alkaline reaction.

FUMAROLE, a hole from which steam or smoke issues, as in volcanic districts.

FUMAY, a town of France, in the department of Ardennes, situated on the Meuse, 20 miles north of Mezières, and connected by rail with Mezières and Rheims. It has quarries, iron-foundries, and breweries. Pop. (1896), 5087.

FUMIGATION, the disinfecting of the air of rooms, and of clothes, furniture, &c., by means of fumes or vapours. The most efficacious substances for this purpose are chlorine, the vapour of nitric acid, and that of muriatic (hydrochloric) acid. The fumes of heated vinegar, or the smoke of exploded gunpowder, are of but little or no value. In fumigating rooms sulphur is commonly used, the windows being tightly closed and all apertures as far as possible blocked up. Articles of clothing, bedding, &c., should be hung on lines. An iron vessel is placed in the middle of the room, containing one pound or more of sulphur, according to the size of the room, and when all is ready the sulphur is ignited by placing a live coal upon it. The doors are then closed, and the room left so for twenty-four hours. See also DISINFECTANTS.

FUMITORY (*Fumaria officinalis*), a plant of the order Fumariaceæ (Fumeworts), growing in Great Britain as an annual weed in hedgerows and gravelly and sandy places. It is a trailing, succulent plant, with triternate leaves, and has its rather pretty flowers in long, erect racemes, on the opposite side of the stem from the leaves. They are of a pale-purple colour, with a dark tinge near the points. The calyx consists of two membranous, ragged scales, the corolla of four petals, crossing each other in pairs, and adhering by long claws; one has a pouch or spur at the base. There are six stamens united by filaments into two parcels so as to appear only two. The fumitory was formerly much used medicinally both in Great Britain and in France, but has now fallen almost entirely into desuetude. There are other British species.

FUNCHAL, a Portuguese town, the capital of the island of Madeira, situated on a bay on the south coast. It stretches for nearly a mile along the shore, a number of the smaller streets or lanes extending up the steep slope of the hill behind. The streets are narrow and crooked, but well paved. The houses of the poorer classes are in general low, seldom exceeding one story in height, and neatly whitewashed. The residences of the wealthy are large, handsome buildings. There are a cathedral, Anglican and Presbyterian places of worship, convents, &c. Wheel-carriages are almost unknown, a sort of sledge being used for transporting pipes of wine from one place to another. Travelling is performed in sedan-chairs. The town is defended by four forts. The electric light has been introduced, and schemes for draining the town and introducing a sufficient water-supply have been approved. Funchal is a coaling station and place of call for steamers, and is much resorted to by invalids from Britain afflicted with pulmonary and other complaints. The trade is of some importance, and is largely in English hands. Wine, bananas, early vegetables, embroidery, eggs, wicker-work (chairs, tables, baskets), &c., are exported. The British ships taking part in the trade of Funchal in 1902 were 941 out of a total of 1513. There is practically no winter at Funchal. The annual rainfall is about 20 inches. Pop. (1900), 44,049.

FUNCTION. In mathematics, if the value of a quantity depends on that of some other quantity, the former is said to be a *function* of the latter. Thus, for instance, the area of a circle is a function of the radius, being a constant number multiplied by the square of the number that expresses the length of the radius. The sine, cosine, tangent, of an angle are functions of the angle. We may also have quantities that are functions of two or more other quantities. Thus, the area of a triangle is a function of any two of the sides, and the angle that they contain. Usually, when the word function is employed the algebraic expression of the relation between the first-named quantity and the quantity or quantities of which it is a function is referred to; and in order

to indicate in a general way that one quantity y is a function of another x the notation—

$$y = f(x),$$

or something similar, is employed. In the example above mentioned, if u be the area of a triangle, x and y two of the sides, and θ the angle contained by them, we should write—

$$u = \phi(x, y, \theta),$$

to indicate the fact that the magnitude u depends on the values of all the three quantities, x, y, θ. Functions are divided into algebraic and transcendental functions. An algebraic function is one that may be expressed by a finite number of terms, indicating algebraic processes. Thus, $u = ax^2 + bxy + cy^3$ is an algebraic function of x and y. Such functions as $u = \sin x$, $u = y \log x$, $u = (x^2 + y^2)e^x$, are called transcendental.

FUNCTIONS, in biology, the actions proper to tissues, organs, or groups of organs. The function of respiration is the joint action of lungs and skin; digestion is a very compound function, to which organs and groups of organs contribute. The actions are capable of being grouped in subordination to three leading phenomena of every living thing—namely, sustentation, reproduction, and relation. To the first belong digestion and all the other functions which contribute to the vegetative life; the processes of the second are, as examples of cell transformation, so far identical with those of the other two, but the results are different; the cell changes of the nervous system which regulates the relations of living things are again identical with those of the other two sets of phenomena. Chemical change, heat, electricity, and other modes of motion, in short, the same forces whose phenomena we recognize in the inanimate world, stand in the same relation to organized as to unorganized matter. The old distinctions of animal, natural, and vital are now abandoned, vital being only used by those who refuse to refer all organic processes to the operation of mechanical laws, and who appeal to unknown and undefined influences. —*Functional diseases* are those due to organs perfect in structure but not performing their functions properly; as opposed to organic or structural diseases, due to defect of structure.

FUNDAMENTAL NOTE, the lowest or gravest note that a string or pipe can sound. The fundamental note of a stretched string is sounded when the string vibrates as a whole. The fundamental note of an open organ-pipe is sounded when there is one node at the middle of the pipe. In a closed organ-pipe there is no node at all when it is sounding the fundamental note; or more properly, the node is at the closed end of the pipe. See also HARMONICS, MUSIC.

FUNDI, FUN-DUNGI (*Paspalum exile*), a kind of grain allied to millet and much cultivated in the west of Africa. It is light and nutritious, and has been recommended for cultivation in Britain, for the use of invalids and persons of weak digestion. The genus has a wide distribution, and comprises many species.

FUNDS, PUBLIC, and FUNDED DEBT. Nearly all governments have at some time or other found themselves under the necessity of anticipating their revenue by borrowing; and owing especially to the expensive wars undertaken and the revolutions undergone by most of the governments of Europe and America, as well as by many of those of Asia and Africa, there is hardly a considerable state in the world which has not a large public debt. Governments, like individuals, usually begin to borrow with the intention, or at least with the promise, of repaying within some definite period the amount they have borrowed. In the case of governments this expectation is rarely fulfilled. The amount borrowed in time of national difficulties is commonly so large, and the process of recovery so slow, that the time of redemption is usually past before any serious effort can be made to liquidate the debt, if indeed the government is not then strenuously engaged in endeavouring to contract a new one. This consideration, together with that of the duration of national life, which is greater than that of the individual, has led to the general adoption by prudent governments, in contracting large debts, of the plan of funding. Funding a debt, in its present acceptation, means simply rendering it irredeemable, or redeemable only at the option of the borrower. Thus there are at present two kinds of funded debt in Great Britain—terminable annuities, in which the payment of interest for a given term of years, or for the life of the annuitant, extinguishes the debt; and permanent funds, upon which interest is due till the redemption of the debt, but in which no period is fixed for redemption. To this class belongs the great bulk of the national debt.

The origin of funding debt is not due to the deliberate foresight and prudence of governments. It seems in most cases to have been accidental, and to have arisen as a compromise between the violence and despotism of governments in their financial expedients and the importunity of those whom they compelled to contribute to their necessities. The first historical instance of funding on record in Europe is probably that which originated in a forced loan raised by the Doge Vitale Michele of Venice about the middle of the twelfth century, which led to the incorporation of a Chamber of Loans, which became in 1171 the Bank of Venice. In Great Britain the funding of debt had a similar origin. Charles II. repudiated a debt of £1,328,000, payment of interest on which was afterwards resumed, and in 1699 made permanent by act of Parliament at 3 per cent. In cases like this the capital is not entirely lost to the lenders, but the interest of the loan is probably very different from what it would have been had the conditions been fairly announced; and if the lender wishes to realize his capital by selling the loan in open market he will probably receive much less than he paid. Funding as a systematic method of borrowing was begun in Great Britain after the Revolution, to defray the cost of the wars of William III., and the method has since been generally adopted in European practice. At first some specific source of revenue was assigned to bear the charge of interest and redemption of the debt incurred, and the term fund was frequently applied to this branch of revenue. Now, however, the revenue of the country generally is held to be chargeable with the whole burden of the debt, and the term funds is applied to the capital of the debt itself.

Two methods of funding debt have prevailed at different times in Great Britain, which seem to differ very little except in a detail of arrangement. In times of war and difficulty the rate of interest is generally high, and when tranquillity is restored and confidence returns it again subsides. A government, therefore, always borrows in unfortunate circumstances. The plan usually adopted up to the reign of George II. was to offer a sufficiently high rate of interest to induce capitalists to make the loan required. After that period the plan was adopted of offering a uniform, or nearly uniform, rate of interest (3 or 3½ per cent), and funding a larger capital at this rate of interest than the amount actually received. Thus, in 1815 every subscriber of £100 to the funds received £174 of 3-per-cent and £10 of 4-per-cent stock. M'Culloch (Commercial Dictionary, article Funds)

insists that by the latter mode of borrowing a very serious disadvantage is incurred. His reason is, that if government borrows at high interest during war it can reduce the interest by borrowing at a lower rate during peace and repaying the old debt; whereas, if the capital as well as the interest of the original debt is enlarged, it can only be paid off at a sacrifice, and the high interest is thus rendered permanent. There is a certain amount of truth in this reasoning, but it will not sustain the calculation of actual loss based on it. It is clear that when a government, in borrowing at a comparatively high interest, enlarges at the same time the capital for which it becomes bound, so as to make the rate of interest a low one in proportion to the amount of incurred liability, it precludes itself from afterwards reducing the rate of interest; but it would seem that this was precisely what it intended to do. Every capitalist who lends money at a high rate of interest knows very well that his debtor will not continue to pay this rate longer than he can help. In determining his rate the duration of the investment enters as a most important element into his calculation. There is no reason therefore to suppose that government, in giving a guarantee of the permanence of the investment, did not get the full market value of that guarantee.

The real force of the objection amounts to this, that by the plan adopted government made a permanent investment in an unfavourable market, while it might have made a temporary one, and waited a more favourable opportunity for renewing it. It is certain that the adoption of this plan was an error *if it could have been avoided.* As it is more expensive to borrow than to depend for expenditure upon revenue, so every refinement on the art of borrowing adds to its charge. A government which can borrow without that condition would therefore act very impolitically in giving any guarantee of permanence in the rate of interest, but this is precisely what it was not known that the government could do. It is significant that the plan objected to was not adopted till the government had begun to be heavily indebted, and a debtor whose obligations are heavy cannot go into the market on the same terms as a free man. In the instance we have given the rate of interest actually paid by Britain for a permanent investment was £5, 12*s.* 4*d.* per cent. This is certainly higher than would be paid now, still it is not an extreme rate. We cannot tell what might have been demanded without the guarantee of permanence, but it may be assumed, from the capital obligation being nearly doubled, that without any increase of capital it would have been at least a half more. Now, besides the additional charge, there is a disadvantage to a debtor who wishes to borrow largely, in paying a high rate, that it injures his credit. Had the government borrowed at 7 or 8 per cent the mere fact of its doing so would soon have run the rate still higher, and perhaps have ultimately closed its credit altogether. It would seem then that government acted most prudently in resorting to every means to keep the present rate of interest as moderate as possible.

For a brief history of the national debt see BRITAIN.

FUNDY, BAY OF, a large inlet of the Atlantic, on the east coast of Canada, separating the southern part of the peninsula of Nova Scotia from New Brunswick, extending 100 miles south-west to north-east, and about 30 miles average breadth. At its upper extremity it sends off two extensions or arms —Chignecto Bay on the north and Minas Channel on the south—the latter leading into Minas Basin and Cobequid Bay, and the former dividing to form Shepody Bay and Cumberland Basin. The bay receives the waters of the St. John, the St. Croix, and numerous other rivers. The bay is deep, but its navigation is dangerous. At its entrance are Grand Manan and other islands. The tides sometimes rise to the height of 70 feet. A ship-railway has been constructed across the narrow Chignecto isthmus to connect this bay with Northumberland Strait and the Gulf of St. Lawrence.

FUNEN (Danish, *Fyen*), the largest of the Danish islands, except Seeland, from which it is 16 miles west. It is separated from the mainland on the west by the Little Belt (which narrows so as to resemble a river), and from Seeland on the east by the Great Belt; circuit, about 185 miles; area, 1125 square miles. The coast is steep and much indented. The interior, towards the west, is covered by a range of low hills; but, with this exception, it is composed of large and fertile plains, under good cultivation, and producing large quantities of corn, much of which is exported. The largest stream is the Odense, which has a course of about 36 miles. The largest lake is the Arreskov, which is about 3 miles long by 3 miles broad; is tolerably deep, and teems with fish. A canal extends from the town of Odense (the capital) to the Odense Fiord, and the island is traversed by several railway lines. Besides Odense, it contains also the towns Svendborg and Nyborg. The population in 1901 was 279,501.

FUNERAL EXPENSES. By the law both of England and Scotland funeral charges form a privileged debt, and are paid, along with other preferable debts, previous to ordinary claims. The executor or administrator must bury the deceased (testate or intestate) in a manner suitable to the estate he has left. If he exceeds a reasonable expense he incurs the responsibility of committing a *devastavit*, or wasting the property of the deceased. In Scotland, suitable mourning for the widow and for children present at the funeral are included among necessary expenses. In England, only actual necessaries will be allowed against the creditors for the funeral of an insolvent debtor.

FUNERAL RITES. Religious dogmas combine with physical circumstances to decide the character of the last tribute of friendship and love paid to the remains of the dead; nor is it always easy to determine which of these causes may have led one nation to preserve the corpse by an artificial and expensive process, another to reduce it at once to its original elements, and others to leave it in the earth at the disposition of nature. On the other hand, we find the influence of religious opinions in many cruel, absurd, and revolting practices, which have prevailed in some countries, and their milder and better influences in the touching yet consoling usages of others. Of individual funeral rites we can only speak briefly.

Among the Hindus the corpse is perfumed and adorned with flowers; it is then burned; after many ceremonies the bones are deposited in a casket and buried, but afterwards disinterred and thrown into the Ganges. A second series of obsequies commences after the period of mourning has expired, and this is followed by commemorative rites. The voluntary immolation (*suttee*) of the widow of the deceased, now abolished, was the most remarkable part of the ceremony. The Mohammedans bury their dead. The interment takes place as soon as possible, in obedience to the command of the prophet: 'Make haste to bury the dead, that, if he have done well, he may go forthwith into blessedness; if evil, into hell-fire'. No signs of excessive grief, no tears nor lamentations, are allowed, as it is the duty of a good Mussulman to acquiesce without a murmur in the will of God. On arriving at the burial-place the body is committed to the earth with the face turned towards Mecca. Monuments are forbidden by the law, but they



Fig. 1, Vertical Section through Fungus 2, Under surface of Pileus or Cap. 3, Reproductive Organs. 4, Amadou or German Tinder 5, Edible Cantharellus. 6, Common Mushroom. 7, Smaller Fasciculate Agaric. 8, Sweet-smelling Hydnum. 9, Imperial Mushroom. 10, Goat's beard or Yellow Flavaria. 11, Fly blown Mushroom. 12, Socket Peziza. 13, Bell-shaped Bird's-nest. 14, Dry rot Fungus. 15, Umbellate Polyporus 16 Hypoxylon polymorphum 17, Longitudinal Section of do. 18, Truffle 19, Delicious Agaric 20 Edible Boletus 21, Edible Helvella. 22, Round-headed Morel. 23 Latticed Stinkhorn. 24, Warty Puff ball. 25, 26, Hysterium of the Ash. 27 29 Brown Pulvinate Sphæria

are constantly erected. The Egyptians, it is well known, embalmed their dead. Among the Jews the next of kin closed the eyes of the deceased; the corpse was then washed, and, in the case of persons of some consequence at anyrate, laid for a time in spices or anointed with spices, swathed in linen bandages, and deposited in the tomb. The mourning customs of the Jews may be collected from various passages of the Scriptures. They went bareheaded and barefoot, covered their mouths and kept silence, put on sackcloth and sat in ashes; funeral songs were sung by persons hired for the purpose. Splendid monuments were sometimes hewn out of the solid rock, with numerous niches: as each niche was filled its entrance was stopped up by a large stone rolled against it. In the religious creed of the Greeks and Romans sepulture was an act of piety to the dead; without it, the spirit had to wander a hundred years on the banks of the gloomy Styx. The last breath was generally caught by a near relative, who opened his mouth to receive it; the body was washed and crowned with flowers, a cake of flour and honey placed in the hand, as a bribe for Cerberus, and an obolus in the mouth, as a fee for Charon. Interment and burning were practised indifferently. In interment the body was placed with the face upward and the head towards the west. In burning the pile varied in form and materials: it was lighted by the nearest relative; perfumes and wine were poured on it, and the richest clothes of the dead were burned with him. The ashes were then collected and deposited in an urn. This description applies to the Greeks and Romans, whose rites were nearly identical. Inhumation was the original practice of the Romans; nor did burning become common till the end of the republic. Eulogies were often delivered at the funerals of distinguished men, both in Greece and Rome, and funeral games were exhibited in honour of the dead. Burning was not disused till the close of the fourth century. Macrobius speaks of it as already antiquated in his time.

In the Roman Catholic Church the body is washed immediately after death, a crucifix is placed in the hands, and a vessel of holy water at the feet, with which the visitants sprinkle it. The ecclesiastics remain with it till the interment, offering up prayers. When the time of burial arrives the priest bearing the crucifix stands at the head, and the officiating priest at the foot, of the coffin. The coffin is sprinkled thrice with holy water, and the De profundis and Miserere are chanted. The body is carried to the church, during which time psalms are chanted, especially the Miserere, and, at the close of each, a requiem. In the church the office of the dead is performed, and the mass is celebrated. In conclusion, the body is thrice censed and sprinkled with holy water. At the grave a prayer and benediction are pronounced, and the body and grave are thrice censed and sprinkled with holy water. The anthem Ego sum Resurrectio then commences, during which the body is again thrice sprinkled. A prayer, followed by an anthem, Si iniquitates and De profundis, succeeds; and the body, with the feet towards the east, is lowered into the grave, each of the mourners, before it is covered, sprinkling it in turn. The dead are commemorated on the third, seventh, and twentieth day after interment, and on their anniversaries. The Church of England funeral service is too well known to require any notice. Among other Protestant bodies there is usually no formal service, but prayer is offered up or an ordinary religious service held before the interment in the house of the deceased or his relatives, or, in the case of a public funeral, in some public place. The wake, or watching, is celebrated in some parts of the United Kingdom, particularly in its remoter districts. Burial feasts, or 'arvels', are still given in various localities. A famous instance of this kind occurred in 1828, at the funeral of Mac Mhic Allister, Glengarry, chief of the Macdonalds, when 150 gentlemen sat down to dinner, and 1500 attendants were regaled with bread and cheese and whisky. In North Wales the *myl nôs* is kept with solemnity. The friends bring a pic-nic supper, and pass the night before the funeral in singing psalms and reading the Scriptures. In Ireland the wake of the lower classes is usually a scene of tumult and drunkenness. See BURYING-PLACES and MUMMIES.

FÜNFKIRCHEN (Hungarian, *Pecs*), a town of the Austrian Empire, district of Baranya, Hungary, on the slope of a hill in a wide and beautiful valley, 105 miles S.S.W. Pesth. It consists chiefly of four principal streets, which proceed in the direction of the cardinal points from its four gates, and terminate in a spacious central square. It is the see of a bishop, whose palace, situated on a height above the town, is one of the most conspicuous edifices, and has a good library, with a cabinet of coins. The cathedral, a handsome Gothic structure, is one of the oldest ecclesiastical edifices in Hungary. The chief manufactures are leather and tobacco, the two great staples of the town; woollen cloth, flannel, paper, starch, and vinegar; and the trade includes, in addition to these articles, gall-nuts, wine, silk, and oil-seeds, the last two in particular being extensively raised in the district. Fünfkirchen once had a flourishing university, attended by 2000 students. It has thermal springs; and in the neighbourhood, near Mount Meseck, which commands a magnificent view, coal is worked, and there are quarries of black marble. There are also numerous remains of mosques, baths, and other Turkish edifices, Fünfkirchen having been in possession of the Turks from 1543 to 1686. About 7 miles distant is a remarkable stalactite cavern. Pop. in 1890, 35,416; in 1900, 43,982.

FUNGI (see plates), an extensive group of cryptogamic plants, including mushrooms, toadstools, rusts, smuts, and mildews. With the Algæ (seaweeds, &c.) they form the great subdivision of the vegetable kingdom known as Thallophyta, but, unlike the Algæ, they are all parasites or saprophytes without chlorophyll. Lichens, formed by the symbiotic union of algæ and fungi, are also included among thallophytes. Fungi are found all over the globe, but are most numerous in moist temperate climates. Decaying vegetation is what they mostly live on, but animals are also subject to their ravages, though such cases are comparatively rare. Even man himself does not escape, as certain cutaneous disorders are occasioned by fungous growths. 'They attack the housekeeper's bread, cheese, vinegar, paste, yeast, preserves, and mustard, the farmer's corn and potatoes, the vintager's grapes, the gardener's berries, and the joiner's timber; while a host of forms prey upon the living tissues of plants, scarce any of which are free from their depredations, and many of which are assailed by a dozen different species at once.' Fungi are of purely cellular growth. They form no woody fibre like flowering plants, nor do their tissues contain chlorophyl. They consist of mere aggregations of homogeneous cells. Though many become corky, woody, and horny in the course of their growth, they have no other identity with true wood than that of density and weight, and possess none of the complex structure of flowering plants. They exhibit a wonderful variety of external forms; but the composition of them all is the same—an aggregation of simple cells. Their earliest vegetation is a prolongation of the membranes of their spores, a name

given to their reproductive seminal dust, which, though performing the office of seeds, differ from true seeds in being mere individual cells. From these arises a delicate, minute, webby growth, called the *mycelium*, which is the true vegetation of the plant, and which gives rise to the reproductive bodies at once, or builds up a receptacle which contains them. It is this mycelium which penetrates and destroys the object on which it is parasitic. It is made up of radiating and intertwining fibres formed of rows of cells placed end to end. These are in many instances so minute that they easily traverse the tissues of living plants and the pores of solid wood. From this mycelium grow the spores, which, in their simplest form, consist of the terminal cell or cells, which drop off to form new plants. They are of the extremest minuteness, a quantity of them appearing to the naked eye like a mere cloud of impalpable powder. As we rise in the scale special structures are formed to bear the spores, either singly or in groups. Still more complex forms build up a special organ called the *peridium*, within which the spores arise contained in little sacs termed *asci*. The large fleshy growths which we meet with in the woods or on trees are processes belonging properly to the reproduction and not to the vegetation of the plant. They are disproportionately large compared with the mycelium, and consist of a main stem called a *stipe*, and an expanded top called a *pileus*, on which the spores are borne in various ways, on gills, ribs, prickles, &c. The mycelium is sometimes reduced to a mere trace of evanescent, floccose growth; while the reproductive body becomes a fleshy mass several pounds in weight. But the spores are always minute, and 10,000,000 have been estimated to exist in a single individual.

Few objects in nature exhibit more gorgeous colours than the fungi. The larger fleshy forms present an endless variety of graduated tints. Some of the *Boleti* exhibit on being broken a remarkable change of colour, the white or yellowish hue of the interior changing instantly to a vivid blue. Their texture is as variable as their colour. Some are almost fluid, others fleshy, papery, leathery, corky, or hard and horny. Their size is equally various, ranging from mere specks to masses some feet in girth. Their rapid growth is astonishing. Puff-balls sometimes grow 6 inches in diameter in a night. Masses of paper pulp thrown out hot from a vat have been found within twenty-four hours filled and swollen with a species of *Agaricus*. Some of the *Coprini* grow up in a night and melt away in the morning sun. Other species, like the *Polypori*, grow very slowly, and add a new layer every year, covering that of the previous season. Their expansive force in growing is very great. Notwithstanding their soft yielding texture, agarics are able to raise heavy stones under which they spring up; and Bulliard tells of a *Phallus* which burst a glass vessel in which it had been confined. They generally appear in the greatest abundance in moist autumn weather, though some are found wherever there is moisture. Some species of *Agaricus* possess a remarkable luminosity, and certain *Rhizomorphæ* growing in mines shed a phosphorescent light of extreme brilliancy. Fungi differ from flowering plants in their chemical influence upon the air. They absorb oxygen and exhale carbonic acid, performing the same office in this respect as animals, which they most resemble in chemical composition. The odours they emit in decay are more like putrescent animal than vegetable matter. Some species of *Phallus* and *Clathrus* emit a most intolerably offensive stench. Others, on the contrary, are very agreeable to the smell, and some in drying acquire a fine aroma. They are quite as variable to the taste.

Fungi are a very ancient article of food, and they are still extensively eaten on the Continent by all classes; but in Britain they are rejected by the great mass of the people, with the exception of a very few species. The species commonly cultivated, the mushroom proper, is the *Agaricus campestris*, which grows wild in old fields and pastures, but is propagated by planting its spawn, which is the mycelium of the plant, in hot-beds. Although this is the most widely used, many other species are equally excellent. The truffle (*Tuber cibarium*) grows beneath the ground, and is eaten with avidity by different animals. Dogs are trained to scent it out by those who collect truffles for market. Among other species eaten, the principal are, *Agaricus caudicinus*, *prunulus*, *orcella*, *procerus*, and *exquisitus*, *Polyporus tuberaster* and *corylinus*, *Lactarius deliciosus*, *Cantharellus cibarius*, *Boletus edulis*, *Marasmius oreades*, *Hydnum repandum*, *Fistulina hepatica*, *Morchella esculenta*, and *Helvella crispa*. These are all fleshy fungi. Many other species known to be at times poisonous are eaten in different countries in different ways. They are dried, pickled, salted, and cooked in an endless variety of fashions. Some of the most virulent poisons are found among fungi, and many fatal accidents have arisen from the eating of poisonous species. Rye-meal containing large quantities of ergot produces a fatal gangrenous disease (see ERGOT). Pickling and salting render many innocuous. *Agaricus muscarius* is one of the most injurious; yet it is used as a means of intoxication by the natives of Kamtschatka. The only fungus used at the present day in medicine is the ergot of rye. The *Lycoperdons* or puff-balls have been used as styptics. Some *Polypori* make admirable razor-strops when sliced with a sharp knife. *Polyporus fomentarius* and *igniarius* furnish amadou or German tinder. *Agaricus muscarius* is used as fly-poison. Some fungi are among the greatest pests of the cultivator. The rusts, smuts, and bunt of grain are fungi of the families Uredineæ, Ustilaginaceæ, and Tilletiaceæ. Their mycelium penetrates the tissues of the plants, destroys their vitality, and, bursting through their cuticles, covers them with myriads of their orange, brown, yellow, or black spores. Dry-rot in timber is caused by the penetrating mycelium of *Merulius lacrymans* and *Polyporus destructor*.

The classification of fungi is not yet finally settled, but there is practically no difference of opinion in regard to the more important groups. Leaving the Bacteria out of account, we may follow one of the recent arrangements and group the members of this class in the three sub-classes Phycomycetes, Mesomycetes, Mycomycetes. The mycelium is unicellular in the first sub-class, multicellular in the other two. The Phycomycetes are reproduced both sexually and asexually, but in the other two groups only asexual reproduction is known. In the Mesomycetes reproduction takes place by means of spores of unlimited number developed in sporangia, or by conidia; but in Mycomycetes reproduction is by spores limited in number and contained in special tubular sporangia called asci (Ascomycetes), or by conidia of limited number on basidia (Basidiomycetes).

The Phycomycetes are subdivided, according to their mode of sexual reproduction, into Oomycetes, reproduced sexually by egg-cells, and Zygomycetes, reproduced sexually by conjugation. In the Oomycetes asexual reproduction by swarm-spores also occurs. The Mesomycetes represent an intermediate stage between the other two groups, and may be subdivided into Hemiasci and Hemibasidii, leading on to the Ascomycetes and Basidiomycetes respectively. The distinction between the two groups of the Mycomycetes has been already indicated.

To the Oomycetes, with about 420 species, belong the following families: (1) Peronosporeæ, including the potato-disease fungus (*Phytophthora* or *Botrytis infestans*) and the false vine-mildew (*Peronospora viticola*); (2) Saprolegniaceæ, aquatic and mostly saprophytic forms, including the salmon-disease fungus (*Saprolegnia ferax*); (3) Chytridiaceæ; (4) Ancylistaceæ; (5) Entomophthoreæ, mostly parasitic on insects, including *Empusa Muscæ*, which attacks flies in autumn. To the Zygomycetes, with 125 species, belong the families: (6) Mucoraceæ, mould-like saprophytic plants, including the well-known *Mucor Mucedo*; (7) Mortierelleæ. In the group Hemiasci are included the families: (8) Ascoideæ; (9) Protomycetes; (10) Thelebolæ; together comprising some twenty species. Two families, with about 160 species, belong to the Hemibasidii, namely (11) Ustilaginaceæ, comprising the smuts, of which *Ustilago carbo* is the chief; and (12) Tilletiaceæ, including *Tilletia Tritici*, the bunt of wheat. Following are the families of the Ascomycetes: (13) Exoascaceæ, with the asci free and exposed on the mycelium, including the witches'-brooms (*Exoascus*); (14) Perisporiaceæ, with asci in a nut-like or tuber-like body, including the mildews, the true moulds (*Aspergillus niger*, *Penicillium*, *Eurotium*, &c.); (15) Tuberaceæ, including such subterranean saprophytes as the truffles (*Tuber*); (16) Pyrenomycetes, having the asci in pear-shaped excavations opening by a pore (perithecia), with an enormous number of species, of which ergot of rye (*Claviceps purpurea*) and some lichen fungi are examples; (17) Discomycetes, with the asci exposed on a disc or cup, a large family including *Peziza*, *Helvella*, the Morel (*Morchella esculenta*), and most lichen fungi. The (18) Saccharomycetes or Yeast-Fungi are usually placed near the Ascomycetes. The great group of Basidiomycetes includes the families: (19) Uredineæ, leaf-parasites known as rusts, with three distinct stages in their life-history which were formerly regarded as fungi of distinct genera (*e.g.* the æcidiospores as *Æcidium*, the uredospores as *Uredo*, the teleutospores as *Puccinia*); (20) Auriculariaceæ, including the Jew's-Ear fungus (*Auricularia sambucina*) of the Elder; (21) Tremellaceæ, comprising gelatinous forms found on decaying trees; (22) Pilacraceæ; (23) Dacromycetes; (24) Hymenomycetes, a very large family, including *Clavaria*, *Polyporus*, Dry-rot (*Merulius lacrymans*), *Boletus*, the mushrooms and toadstools (*Agaricus*, *Amanita*, &c.), *Cantharellus*, *Lactarius*, *Coprinus*, &c.; (25) Gasteromycetes, another large and important family, comprising Puff-Balls (*Lycoperdon*), Earth-Stars (*Geaster*), Stink-Horns (*Phallus*), &c. See Bennett and Murray's Cryptogamic Botany (1889); De Bary's Comparative Morphology and Physiology of Fungi, &c. (Eng. trans. 1887); Saccardo's Sylloge Fungorum (12 vols., Padua, 1882–96); Cooke's Handbook of British Fungi (1887), Illustrations of British Fungi (8 vols., 1884–91), and British Edible Fungi (1891); Massee's British Fungus Flora (3 vols., 1892–93); Percival's Agricultural Botany (1900); &c.

FUNNEL, in steam-vessels, is a large iron tube designed to carry away the unconsumed smoke and gases emanating from the furnace, and to admit a draught to sustain combustion. A steam-pipe is generally attached to it externally. In vessels which have to pass under bridges the funnel is usually made with a joint, which permits it to be lowered while the vessel passes under the bridge. In men-of-war it is usually telescopic, to allow it to be withdrawn during action from injury by shot.

FUR and FUR TRADE. Fur is the fine soft hairy covering of certain animals, especially the winter covering of animals belonging to northern latitudes. The term fur is sometimes distinctively applied to such coverings when prepared for being made into articles of dress, &c., while the name of peltry is given to them in an unprepared state or when merely dried. The animals chiefly sought after for the sake of their furs are the beaver, raccoon, musk-rat, squirrel, hare, rabbit, the chinchilla, bear (black, gray, and brown), otter, sea-otter, seal, wolf, wolverine or glutton, marten, ermine, lynx, coypou (nutria), polecat (fitch), opossum, fox, &c. At one time the beaver (*Castor Americanus*) was perhaps the most important of all these, but it has now greatly declined in importance in consequence of the increased use made by hatters of silk and the furs of the hare, rabbit, seal, &c. It was formerly found over the length and breadth of North America, but in some parts it has been nearly exterminated. The fur of the raccoon (*Procyon lotor*) is durable and cheap, and is hence in great demand in some parts of the world for linings for coats, &c. It is obtained from America. The musk-rat (*Fiber zibethicus*) is found in large numbers on the banks of American rivers. Its fur is not very valuable, and is principally used by hatters. The squirrel (*Sciurus vulgaris*) is another animal which is found in very large numbers, and yields large quantities of fur. The most valuable fur obtained from this animal is that covering the back of the gray squirrel. The next in value is the white fur taken from the under parts. The hares which are caught for their furs are the *Lepus Americanus*, *Lepus Virginianus*, *Lepus glacialis* and *Lagomys princeps*. The first is called by the fur-traders a rabbit, on account of its resemblance to the latter animal. The fur of the rabbit is exported from England (where it is little valued) to China and Russia. The chinchilla (*Chinchilla lanigera*), an animal between the squirrel and the rabbit, inhabits the South American countries. Those producing the darkest coloured skins are considered the best, and are obtained from the Chilian Andes, as well as from the Andes of southern Peru. The skins of the black bear and gray bear (or grizzly bear, as it is usually called), are used for various purposes which require a strong and durable material, as for making military caps, housings, sleigh robes, &c. That of the brown bear is used for articles of dress. The fur of the otter (*Lutra vulgaris*, *Canadensis*) is chiefly obtained from America, but partly also from England, from a smaller variety of the species, and from the East Indies. The sea-otter (*Enhydra marina*) is obtained from the shores of the Pacific on the N.W. of America, and the east of Siberia. Its fur is highly esteemed by the Russians and the Chinese. The fur-seal, which is obtained in large numbers from Alaska, has a dense under-coat of fine fur remarkable for its extreme softness, and highly prized, being usually dyed of a deep brown colour. The various species of marten (*Martes zibellina*, *M. abietum*, *M. sarmatum*, *M. foina*, *M. Canadensis*, *M. vison*) yield the valuable fur known as sable. They mostly belong to Siberia and Lapland, but the last two species are American. The ermine (*Mustela erminea*) belongs to a closely allied genus. It is found only in Russia, Sweden, and Norway. In winter its fur changes from a dingy brown colour to pure white, except at the lower part of the tail, which is jet black. This part is usually inserted as an ornament on the white fur, but the paws of the black Astrakhan lamb are often substituted for it. The lynx (*Felis Canadensis*, *F. rufa*) yields a soft, light, warm fur, naturally of a grayish colour, but usually dyed black. The first of the two species mentioned is what is generally called by the fur dealers 'cat.' The fur of the nutria or coypu was formerly obtained in large quantities from Chili, Patagonia, and La Plata, and was much

used by hat-makers, but the supply has now fallen off. The fox is found abundantly in the arctic regions. There are several varieties, distinguished by the colour of their fur, black, silver, cross, red, white, blue. The fur of the skunk, more especially the black portions of it, is also highly valued.

All the preparation that skins require before being sent to the market is to make them perfectly dry, so as to prevent them from putrefying. This is done by exposing them to the heat of the sun or a fire. The small skins are sometimes previously steeped in a solution of alum. When stored in large quantities they must be carefully preserved from dampness, as well as from moths. In order to save them from destruction by the latter means they are strewed with camphor when first stored, and periodically each skin is beaten with a stick, so that the worms of the moths fall on the ground, where they are immediately crushed. The fur-dresser, on receiving the skins, first subjects them to a softening process, usually by placing them in tubs, with a quantity of rancid butter, and trampling upon them. He next cleans them from loose pieces of the integument, by scraping them with an iron blade, then removes the grease by trampling them in a mixture of saw-dust. Finally, the fur is combed, after which it is handed over to the cutter, who cuts the furs out into the various shapes required to make different articles. For information regarding the methods of using fur in felting, see FELTING.

For many centuries the Baltic ports were the great dépôts of the fur trade, the furs being brought thither from Livonia, Sweden, Norway, Northern and North-eastern Russia, and later also from the distant Siberian settlements by caravans, which deposited them at the great market-towns of Moscow and Nijnei-Novgorod. The discovery of the American continent soon changed the current of this traffic, for though sables and ermines still came only from Northern Europe and Siberia, yet the American forests and waters furnished in countless numbers the beavers —then regarded as one of the choicest of furs—the pine and stone martens, the mink, lynx, badger, raccoon, the choicest and most beautiful species of the fox, the seal and sea-otter, the Virginia opossum, the musk-rat, and among larger animals, the bison, arctic, grizzly, and black bears, and the large gray wolf. This fur trade was almost wholly monopolized by three or four great trading companies within 100 or 150 years after the discovery of the continent. The Dutch East India Company was first in the field, and carried on a thriving trade, almost exclusively in furs, with its trading ports of New Amsterdam (New York), Beaverwyck (Albany), and one or two points on the Delaware River, as well as at several points on the coast of Maine from 1609 to about 1684. The French very soon established themselves in the same trade in Canada, and further north and west, their chain of forts and trading posts extending at one time from Hudson's Bay to New Orleans. Quebec and Montreal were at first trading posts. The trade was a barter of guns, cloth, ammunition, &c., for the beaver and other furs collected by the natives, and was effected by the intervention of the half-breed *voyageurs, engagés,* or *coureurs des bois.*

In 1670 Charles II. granted to Prince Rupert and others a charter empowering them to trade exclusively with the aborigines of the Hudson's Bay region. A company, then and after called the *Hudson's Bay Company,* was formed in consequence. The trade was at that time highly lucrative. During the first twenty years of its existence the profits of the company were so great that, notwithstanding their losses by the capture of some of their establishments by the French, they were able to pay to the proprietors in 1684 fifty per cent. in 1688 another fifty per cent. and in 1689 twenty-five per cent. In 1690 the stock was trebled without any call being made, and in 1720 it was again trebled with only a call of ten per cent. from the proprietors; and on this stock high dividends continued to be paid for a long series of years. In the winter of 1783–84 another company was formed at Montreal, called the *North-west Fur Company,* which disputed the right of the Hudson's Bay Company, and actively opposed it. The Earl of Selkirk was at that time at the head of the Hudson's Bay Company, and conceived the plan of planting a colony on the Red River to the south of Lake Winnipeg. Of this colony the North-west Company was jealous. In consequence of this, and the evil feelings naturally growing out of a contrariety of interests, a war ensued between the servants of the parties, and a loose was given to outrage and barbarity. Wearied at last (the Hudson's Bay Company having latterly been unable to pay any dividends), the companies in 1821 united, retaining the name of the *Hudson's Bay Company,* and having now a capital of £400,000. The monopoly which had hitherto been enjoyed by the original company about Hudson's Bay was now extended over the whole of British North America, from 60° to 142° w. lon., except Canada, Newfoundland, British Columbia, and the east coast provinces; but in 1868 an act of Parliament was passed to make provision for the surrender, upon certain terms, of all the territories belonging to the company, and for their incorporation with the Dominion of Canada. On the 9th of April, 1869, the surrender was actually carried out, Canada paying £300,000 to the company by way of compensation. The company still preserved its settlements already formed with the adjoining land, and one-twentieth of the districts in the fertile zone of the north-west, which at the time of surrender had been set apart for settlement, although not yet settled. The Hudson's Bay Company possesses about 150 houses, forts, and posts in the whole region formerly belonging to it, and its operations, indeed, extend beyond British America into the United States and to the Sandwich Isles and Alaska. It employs directly somewhere about 3000 agents, traders, voyageurs, and servants, besides Indian hunters. Some of its posts are situated very far north, almost approaching the Arctic Ocean.

These forts or trading posts are all much alike in construction and general arrangement. They are built usually in the form of a square, or nearly so, of about 100 yards. This space is picketed in with logs of timber driven into the ground and rising 15 to 20 feet above it. In two of the corners is usually reared a wooden bastion, sufficiently high to enable the garrison to see a considerable distance over the country. In the gallery of the bastion five or six small guns—six or twelve pounders—are mounted, covered in, and used with regular ports like those of a ship; while the ground-floor serves for the magazine. Inside the pickets are six or eight houses; one containing the mess-room for the officers at the post, and their dwelling-house where their number is small, two or three others being devoted to the trappers, voyageurs, &c. Another serves for the Indian trading store, and in one are kept the furs, which remain in store at the inland posts during the greater part of the year. Some of these posts have seen hard fighting, having been in former times defended against hostile Indians or against the rival traders of the old North-western Company. The company used to rule in its territories with almost absolute sway, and on the whole exercised its power well and justly, gaining the affection and respect of the Indians by kindly intercourse and just dealing.

Of the fur-bearing animals of North-western America, and the method of taking them, Milton and Cheadle in their North-west Passage by Land, write as follows:—The animals which furnish the valuable furs from this region are the silver and cross foxes, the fisher, marten, otter, mink, and lynx—whilst among those of less worth are the wolverine, beaver, ermine, and musk-rat. Of these the silver fox commands the highest price. Its fur is of a beautiful gray, the white hairs, which predominate, being tipped with black, and mixed with others of pure black. A well-matched pair of silver fox skins are worth £80 to £100. The cross foxes, so called from the dark stripe down the back, with a cross on the shoulders like that on a donkey, vary in every degree between the silver and the common red fox; and the value of their skins varies in the same ratio. After the best cross foxes come the fisher, the marten, and the mink. These three are all animals of the polecat tribe, and both in size and value may be classed in the order in which they have been mentioned. . . . By far the most numerous of the more valuable fur animals in this region are the marten and the mink, and to the capture of the former of these two—the sable of English furriers—the exertions of the trapper are principally directed. At the beginning of November, when the animals have got their winter coats, and fur is 'in season,' the trapper prepares his pack, which he makes in the following manner:—Folding his blanket double he places in it a lump of pemmican, sufficient for five or six days' consumption, a tin kettle and cup, and, if he is rich, some steel traps and a little tea and salt. The blanket is then tied at the four corners, and slung on the back by a band across the chest. A gun and ammunition, axe, knife, and fire-bag complete his equipment. Tying on a pair of snow-shoes he starts alone into the gloomy wood. When he observes the footprints of marten or fisher he unslings his pack and sets to work to construct a 'dead fall' or wooden trap after the following manner. Having cut down a number of saplings, these are divided into stakes of about a yard in length, which are driven into the ground so as to form a palisade in the shape of half an oval, cut transversely. Across the entrance to this little inclosure, which is of a length to admit about two-thirds of the animal's body, and too narrow to admit of its fairly entering in and turning round, a short log is laid. A tree of considerable size is next felled, denuded of its branches, and so laid that it rests upon the log at the entrance in a parallel direction. The bait, which is generally a bit of tough dried meat, or a piece of partridge or squirrel, is placed on the point of a short stick. This is projected horizontally into the inclosure, and on the external end of it rests another short stick placed perpendicularly, which supports the large tree laid across the entrance. The top of the trap is then covered in with bark and branches, so that the only means of access to the bait is by the opening between the propped-up tree and the log beneath. When the bait is seized the tree falls down upon the animal and crushes him to death. An expert trapper will make forty or fifty traps in a single day.

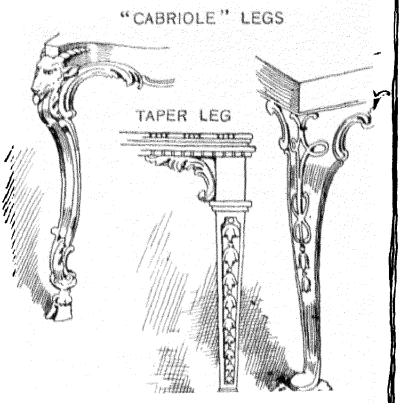
The trade in furs conducted by citizens of the United States has been extensive, but in a greater degree the result of individual enterprise than of the management of gigantic corporations. In 1808, John Jacob Astor established the American Fur Company, with its line of posts across the continent, intending to form a dépôt for furs at the mouth of the Columbia River, and ship the furs directly from that point. He subsequently changed its name to the Pacific Fur Company, and was on the high road to success when in 1813, during the war between Britain and America, the business was sold to the North-west Company. After the transfer of the Pacific Fur Company to the North-west Company, Mr. Astor confined his operations to the regions east of the Rocky Mountains, and for many years transacted a large and profitable business in furs. St. Louis was one of the principal dépôts of the fur trade from 1763 to 1859. In 1827 the Rocky Mountain Fur Company of St. Louis was formed and sent its trappers to the Pacific coast. The perils of the business were very great—40 men out of every 100 perished in its service—but such was the fascination of this life of adventure that enough were always ready to supply the place of the slain. The Russian-American Fur Company, having its principal trading post at Sitka in Alaska, carried on an immense traffic for many years, but its property and rights were transferred to the United States in 1867 simultaneously with the purchase of Alaska. In recent times the fur trade has become more diffused in the hands of individuals, and while the aggregate amount collected each year is much greater than formerly, the opportunities for acquiring fortunes in it have passed away. In 1870 the Alaska Company leased from the United States the famous Pribiloff Islands, in Behring Sea (the largest being St. Paul and St. George), for the purpose of conducting the trade in catching the sea-otter and fur-seal on those islands. The number of fur-seals taken annually approaches 100,000. The skins are worth from £6 to £9 each. Besides North America, Siberia furnishes large quantities of fur to the European markets. The chief locality in Siberia in which fur is obtained is the north-eastern part, and Yakutsk, where great markets are held in June, is the chief centre of the trade in this part of the world. The two great centres in Europe are London and Leipzig.

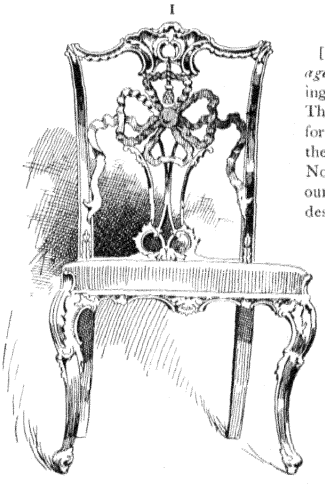
FURCA, or FURCAHORN, an Alpine mountain of Switzerland, canton Valais, immediately west of St. Gothard; height, 9900 feet, containing the glacier in which the Rhone has its source. The summit of the Furca Pass, over which there is a good road, is 7992 feet high.

FURFUROL ($C_5H_4O_2$). A substance got by acting on woody fibre, sugar, sawdust, starch, flour, and similar substances, with oxidizing agents. It was first obtained by Döbereiner in the course of the action which yielded formic acid. One of the best methods of preparing it is by the action of dilute sulphuric acid on bran, and from this source (L. *furfur*), it has derived its name. It is an oily fluid which when pure does not darken in colour, but it is often accompanied by other products which seem to have the power of making it become brown. It has an aromatic odour like oil of cinnamon. Specific gravity, 1·16. Boiling-point, about 340° Fahr. It is moderately soluble in water and readily in alcohol. It burns in the air with a smoky flame, and is readily acted on by oxidizing and other agents. In its chemical functions furfurol is an aldehyde. When left in contact with ammonia it combines with it to form *furfuramide* ($C_{15}H_{12}N_2O_3$) as a bulky mass of crystals. When this is heated with a solution of potash in water it is converted into *furfurine*, which has exactly the same composition, but quite different properties, as it is a strong base. It crystallizes in fine silky needles, which fuse below the boiling-point of water, and solidify to a resinous mass. It dissolves in hot water, but separates on cooling; it dissolves readily in alcohol and ether. Furfurine combines with most of the acids to form crystalline salts.

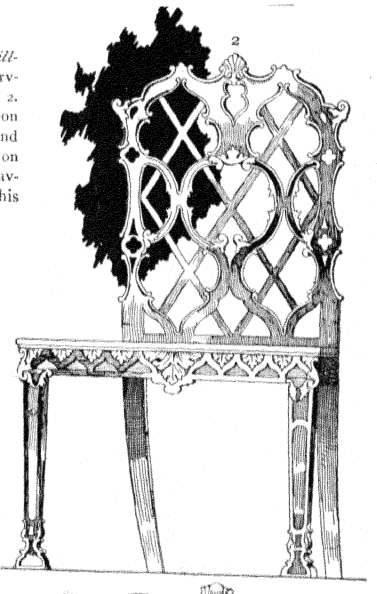
FURIES, EUMENIDES, ERINNYES (among the Romans, *Furiæ* and *Diræ*), deities in the Greek mythology, who were the avengers of murder, perjury, and filial ingratitude. They sprang from the drops of blood which fell from Uranus when he was

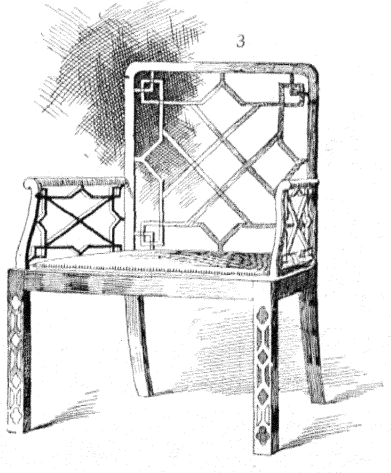


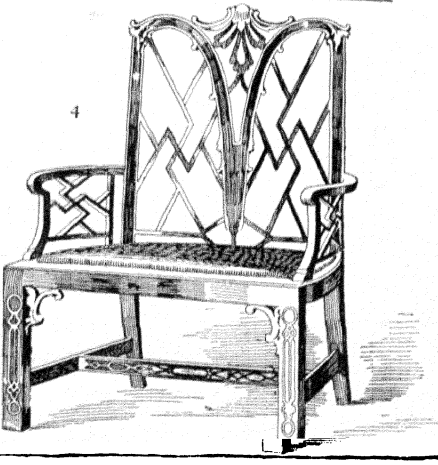




[Note the *coquillage* or shell-like carving on Nos. 1 and 2. The interlaced ribbon forms on No. 1 and the elongated C's on No. 2 were also favourite devices of this designer.]



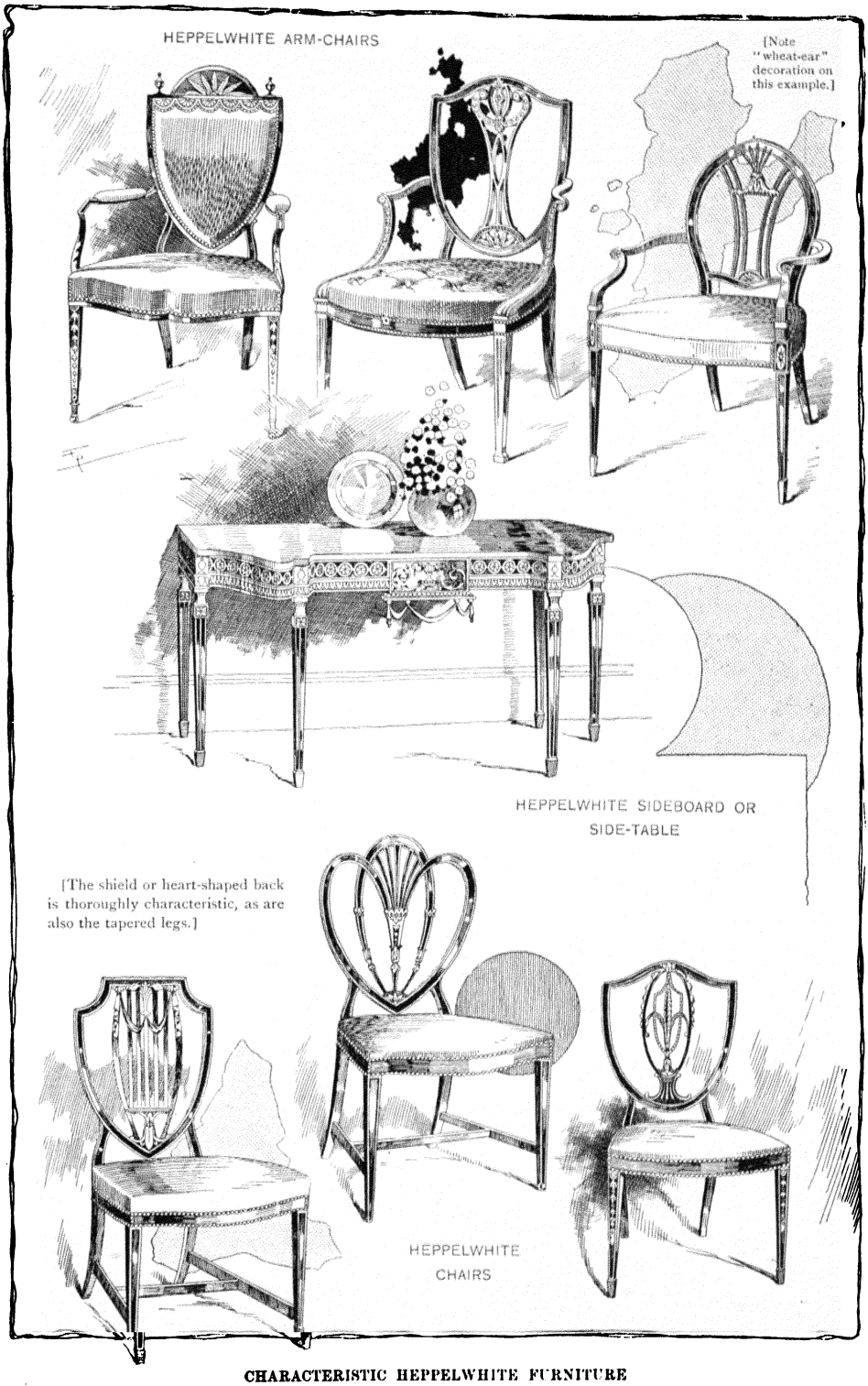




3, 4, CHIPPENDALE "CHINESE" CHAIRS

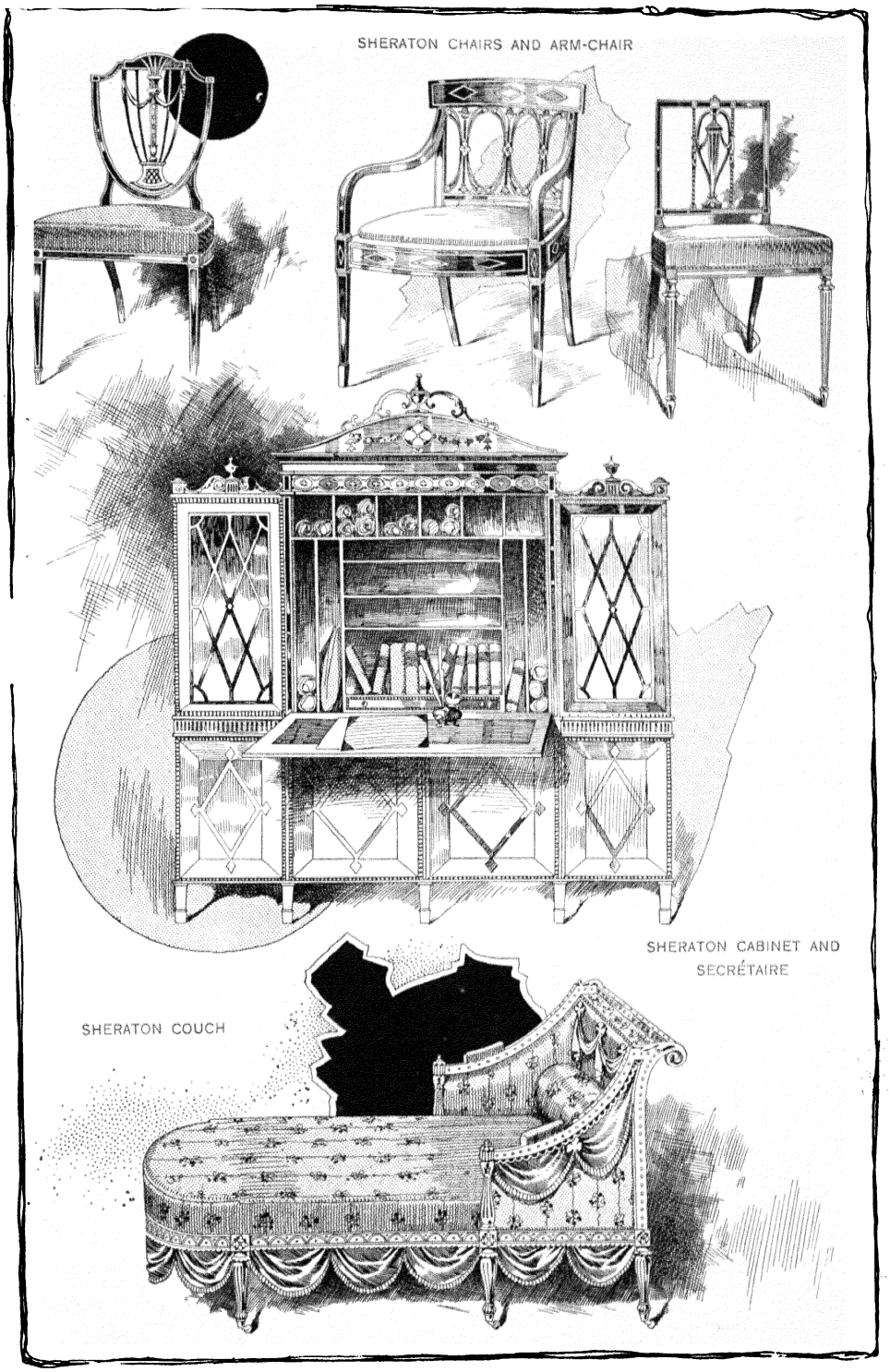
CHARACTERISTIC CHIPPENDALE CHAIR-DESIGNS

Thomas Chippendale flourished about 1750-1760. His "Design Book" was published in 1752.



CHARACTERISTIC HEPPELWHITE FURNITURE

Messrs. A. Heppelwhite & Co., Chippendale's successors, published their "Design Book" in 1789. The Heppelwhites were designers rather than manufacturers.



CHARACTERISTIC SHERATON FURNITURE

Thomas Sheraton (1751-1806) was the last of the famous cabinet-makers of the 18th century. In 1790 he published his first collection of "Designs for Furniture", and this was followed by numerous other publications of a similar class.

nance in the decorated Gothic of the fourteenth century. Articles of furniture previous to 1500 are very rare. The illuminations of MSS. supply more abundant details. For three centuries after the Conquest domestic furniture was very scanty. The hall was furnished with tables and benches, the furniture of a bed-room consisted of little more than a bed and a chest. The floors were usually of wood, strewed with rushes or something similar. Chairs were large and cumbrous, and were usually fixtures; wooden forms, sometimes with back rails, being placed against the walls. Carpets were first introduced in England by Eleanor of Castile, wife of Edward I., but were not generally used until the fifteenth century. The furniture of the dining-room was very limited. Boards on trestles were in general use as tables; the huge salt-cellar was the chief ornament of the board. At royal and noble tables silver goblets, plates, and dishes were seen, but in ordinary houses wooden bowls and trenchers only were used. Earthenware, though made in the form of pitchers and jugs, does not seem to have been applied to the fabrication of plates and dishes. In the fourteenth and fifteenth centuries remarkable progress was made, and a considerable degree of splendour in furniture was attained. Defence began to be not the only object studied in the construction of buildings. The apartments expanded in height, and were hung with the newly invented tapestry of the Netherlands (the workshop and exchange of mediæval Europe), called 'Arras' from the place of its origin. The Gothic pannelling of the carved bedsteads, chairs, screens, &c., was dazzling with scarlet, blue, and gold, and costly embroidered hangings and curtains heavy with heraldic symbolism, cabinets, reading-desks, prie-dieus, ivory and enamelled coffers, fire dogs or andirons elaborately chased and gilt, began to appear, all harmonized to a rich glow of colour by the gemmed and jewelled light that stole through the mullions of the storied windows of 'bower and hall.' The progress of this decorative style was suddenly arrested by the 'renaissance,' or revival of ancient classical art and literature, of which Italy was the earliest seat, and from whence the impulse was given that communicated itself speedily to the rest of Europe. A genuine and self-evolved style instantly went out of fashion, and was discarded for an imitation and counterfeit one based on the copying of ill-understood classic models, which were applied without consideration to the most incongruous objects. The classical temple was the dominant idea in the manufacture of furniture as well as in the construction of a palace or a cathedral, and columns were considered as necessary in one species of art as in the other. All the architectural details of Roman building were then applied to furniture; the lions, griffins, chimeras, &c., of the temple frieze encumbered the stately pillars of the Italian palaces, and caryatides and Roman trophies replaced the patron saint and the crucifix. With all its absurdities, it must be noted that this style was in the hands of great men, and their productions display a boldness and vigour of line, and a mastery over human and animal forms, that give dignity to a licentious freedom of design in which all appropriateness is forgotten. Specimens of the renaissance are still met with, though daily increasing in value. Gothic art never recovered its lost ground. Various articles now of daily use were introduced about this time. Chamber clocks began to be part of the usual furniture of a room. The famous one of silver gilt, designed by Holbein, and presented by Henry VIII. to Anne Boleyn, was purchased by the queen for £110, at the sale of Horace Walpole's effects at Strawberry Hill in 1842, and is now at Windsor. The oldest clock that is supposed to go tolerably now in England is at Hampton Court, of the date of 1540. Looking-glasses or mirrors were now made in Italy, to be suspended on the walls of rooms, and were among the most costly articles of furniture. A little later musical instruments, both a species of hand-organ and the virginals, the earliest form of the modern harpsichord, appear. With various modifications the renaissance style continued dominant for nearly two centuries. In England it degenerated into positive ugliness, the furniture of the time of Elizabeth and James I. having very little to recommend it in tasteful design. It is distinguished by a mixture of overwrought heavy moulding, combined with thin spindly columns, twisted legs, and other inelegant characteristics. Magnificence is sometimes attempted in the value of the material, as in the famous set of chamber furniture in chased silver executed for a royal visit at Knowle Park, the seat of the dukes of Dorset in Kent. It was succeeded by the style named after the French monarch, its patron and encourager, Louis XIV.

The modern predominance of France in the construction of furniture is owing to the minister Colbert. He it was who brought together the best workmen of Europe, and by an edict of the year 1667 established the French royal manufactory of furniture. The new style which the productions of this establishment assumed appears to have been worked out undesignedly, and, like every such successful phase of art, was the genuine product of circumstances. Novelty and magnificence seem to have been the great features aimed at; these were sought by varied treatment of surface in cabinet furniture (as inlays of metals, ivory, enamels, porcelain tablets, tortoise-shell, &c.), and by an incrustation of broken scroll panel work, which hid the real constructive forms and frittered away the graceful outlines of the renaissance into a confused and unsymmetrical mass. The famous artiste, André Charles Boule, who has given his name to the inlaid silver, brass, and tortoise-shell style known as 'buhl work,' was at the head of the royal manufactory with the title of *tapissier en titre du roi.* Under Louis XV. the same school of art continued, and it received new elaboration under the successors of Boule, Riesner, and Gouthier; their works are known to connoisseurs as articles of vertu by the respective styles of each master, and fine specimens bring almost fabulous prices. Probably more of this class of furniture is to be found in Britain than in all the rest of Europe, a great change of owners being brought about by the French Revolution. While the splendid extravagances of Louis XIV. were holding sway in France, the prevailing taste in England seems rather to have been modified by the fashion introduced from Holland by William III. The native woods, oak or wainscot, chestnut, &c., were about this time superseded for furniture by the dark and heavy West India mahogany, the invariable material of the ill-designed and awkward furniture familiar to us in the immortal designs of Hogarth. A better style, based on that of France, was introduced by Chippendale, but a severer and more artistic taste was displayed by the designs of Heppelwhite and Sheraton. In the latter part of the reign of Louis XVI. another change is apparent in French furniture. Greece and Rome were looked up to as standards of correctness in furniture as well as in politics. But instead of impressing their own genius on designs inspired by ancient models, as did the great artists of the renaissance, the authors of this revival were too often content with frigid imitation. The classical style did not long hold sway, and since that time the practice of both France and England (and with them the rest of Europe) has been purely

eclectic. At present designs after the best work of the older makers are much in favour. The English claim the merit of high excellence both in material and workmanship; but probably Paris, at least in some respects, may be regarded as holding the first rank in the production of fine furniture. See Pollen's Ancient and Modern Furniture (1874); Jacquemart's History of Furniture (1878); Litchfield's Illustrated History of Furniture (1892); Chippendale, Sheraton, and Heppelwhite Furniture Designs: reproduced and arranged by J. Munro Bell (1901).

FURRUCKABAD. See FARUKHABAD.

FÜRSTENWALDE, a town of Prussia, in the province of Brandenburg, 21 miles W. Frankfurt, on the right bank of the Spree, and on the Oder-Spree canal. It contains a fine cathedral, a Lutheran and a Roman Catholic church; a gymnasium and other schools; and there are manufactures of machinery, stoves, chemicals, &c. Pop. (1900), 16,765.

FÜRTH, a town of Germany, in Bavaria, in the government of Middle Franconia, 3½ miles west of Nürnberg, at the confluence of the Pegnitz and the Rednitz, which here form the Regnitz. The railway from Fürth to Nürnberg was opened in 1835, and is the oldest in Germany. Communication between the two towns is also maintained by a line of electric tramways The newer parts of Fürth are well laid out, and among the chief buildings and institutions are: the church of St. Michael, dating from the eleventh century; the chief synagogue, originally built in the seventeenth century; the new town-hall, in Italian style; a gymnasium and a royal real school; a city library and an art gallery; an orphanage, hospital, deaf and dumb institution; &c. The industry of the town is largely dependent on the water-power afforded by its rivers, and consists chiefly in the manufacture of Nuremberg wares, especially mirrors, articles in gold and bronze, spectacles, optical instruments, coloured papers, toys, lead pencils, &c., besides brewing. There is an annual fair lasting eleven days. The origin of Fürth is placed in the eighth century. In 1806 Furth was incorporated with Bavaria. Pop. (1900), 54,820, including 3000 Jews.

FURZE (*Ulex Europæus*) is a shrubby plant, very abundant in barren soils throughout the west of Europe. It belongs to the natural order Leguminosæ, and is 3 or 4 feet high, with green striated branches, covered with acute branching spines, and having at their base a few leaves, calyx coarsely pubescent, corolla bright yellow, legumes opening elastically. It often covers large tracts of country, and makes a splendid appearance when in flower. In barren sandy soils this plant is cultivated with advantage for fodder, as the young shoots afford green succulent food relished by horses and cattle, especially when bruised. Furze, *whin*, or *gorse*, as it is sometimes called, is exceedingly difficult of extirpation when it has once obtained possession. It is less hardy than broom, and cannot stand very severe frosts.

FUSE, or FUZE, a contrivance for igniting a charge of powder in a shell or mine. Modern high velocities necessitate the bodies of all shell fuses being made of gun-metal. Safety arrangements are adopted that the means of bursting the shell cannot act prematurely in the gun or during transport. There are four classes of shell fuses: (1) *Time-fuses*, which have a time composition of charcoal gunpowder ignited on the discharge of the gun, and so arranged that after a definite interval its flame is communicated to the bursting charge of the shell during its flight in the air. All time-fuses are put in the nose of the shell. The old wood fuses for smooth and studded shells had quick-match priming round their exterior, which, being inflamed by the discharge, lighted the time composition; but modern gas-checks and driving-bands completely seal up the flame of discharge, hence metal time-fuses are ignited on discharge by a sharp needle striking a detonating cap. The time-fuse shown at GUN, Pl. III., has a detonating cap in its lighting pellet, which is kept locked by bolts retained by spiral springs. When the shell commences to rotate, the locking bolts fly outwards, compressing the springs, and release the lighting pellet, which, flying on a fixed needle, detonates. The time composition is pressed into a groove cut in a metal ring. Other time-fuses have their lighting arrangements put in action by the shearing of a thin suspending wire. The rate of burning of time-fuses is increased by a diminution of the atmospheric pressure. The short time-fuse for the British 15-pounder field-gun has a mean error of about 30 yards. It can burn up to 4100 yards, which, until the South African war of 1899–1901, was considered to approach the extreme range for the practical observation of the smoke of field shrapnel bursts. The Boers had fuses burning up to 6500 yards, and eventually the British had to follow their example. (2) *Percussion-fuses*, which ignite the bursting charge when the shell strikes or grazes. In the direct-action fuse (same plate), the suspending copper disc keeps the needle from touching the detonating cap, but on impact the needle of the disc is driven on to the cap. Some percussion-fuses have a spiral spring placed in front of the lighting pellet to keep it from contact with the needle until the shell is checked by impact or graze, when the unchecked pellet compressing the spring strikes the needle. Lyddite, which is fused picric acid, is detonated by an *exploder* of some metallic picrate, itself initially fired by the black powder of a fuse. (3) *Double-action fuses*, or time and percussion combined. (4) *Delay-action fuses*, in which the percussion arrangement on impact ignites a time composition, so that a little delay occurs to give time for penetration before the burst.

Electric fuses, containing a composition fired by the electrical heating of a fine wire of high resistance, are used to explode black gunpowder mines. Wet gun-cotton is detonated by a *primer* of dry gun-cotton, itself initially detonated by fulminate of mercury contained in a tin tube called a *detonator*, which is generally fired electrically; but in hasty demolitions the detonator is fired either by a *safety fuse* (which is fine-grained powder inclosed in a jute tube burning at the rate of a yard in 60 seconds) or by an *instantaneous fuse* (quick-match burning at the rate of 30 yards in one second when inclosed in a tube). *Tubes* filled with black powder are fired by percussion or electric gun-locks to ignite the powder charges of guns.

FUSEE. See WATCH.

FUSELI, HENRY, more correctly JOHANN HEINRICH FUESSLI, painter and author, was born on Feb. 7, 1741, at Zürich. He early displayed a taste for painting, but was educated for the church, and mastered English, French, and Italian, besides the classical languages, and became acquainted with the works of Shakspere, Milton, Dante, and Rousseau. He and his friend Lavater took orders in 1761 and preached in Zürich, but their share in the exposure of an oppressive bailiff led to their leaving that city in 1763 for Berlin. About the end of the latter year Fuseli went to London, where he first appeared as an author, but not being very successful he showed some of his early sketches to Sir Joshua Reynolds, and the warm encouragement bestowed on him by that distinguished artist decided young Fuseli's fate, and determined him to devote himself to painting. His first picture was Joseph interpreting the Dreams of the Chief

Baker and Butler. In the pursuit of his profession Mr. Fuseli in 1770 visited Italy in company with his friend Armstrong, and while in that country transmitted to England several pictures, especially two taken from the works of Shakspeare—The Death of Beaufort, and A Scene from Macbeth. He left Italy in 1778, and after paying a short visit to his native place, returned to England where he is believed to have suggested to Alderman Boydell the idea of forming the Shakspeare Gallery, for which enterprise he painted eight of his best pictures. In 1790 he became a Royal Academician, and in the course of the next nine years painted a series of forty-seven pictures from Milton, afterwards exhibited as the Milton Gallery. In 1799 he succeeded Barry as professor of painting to the Royal Academy, and in 1804 became keeper to that association. In 1805 he gave to the world an improved edition of Pilkington's Dictionary of Painters, and in 1817 received the diploma of the first class of the Academy of St. Luke at Rome. Fuseli continued to paint till within a week of his death, which took place while he was on a visit to the Countess of Guildford at Putney Hill in 1825.

FUSEL OIL, a heavy oily inflammable fluid with a high boiling-point, disagreeable cutting odour and pungent taste, which is separated in the rectification of ordinary spirit from grain, malt, potatoes, molasses, beet-root, &c. The composition of this fluid depends on the materials used in the manufacture, but it may be said to consist to a large extent of ethylic and amylic alcohol ($C_5H_{12}O$), the fifth in the methylic series (which see); but propylic, butylic, and other alcohols have been met with, and compound ethers formed by the action on these alcohols of the corresponding fatty acids. These bodies, or some of them, seem to be produced during the fermentation, and to their presence is undoubtedly due the flavour of the different kinds of spirit prepared in the ordinary way by distillation. But while some of these bodies are carried over by the spirit, the greater portion—having a high boiling-point—remains in the still, and constitutes the fusel oil, which is run away as waste, unless it be utilized for burning. In the manufacture of pure flavourless or silent spirit, as by Coffey's still, the fusel oil is removed as completely as possible, and can either be run off or kept for use. The detection of fusel oil in a specimen of spirit is easily effected. The odour of the spirit, especially when diluted with water, soon betrays its presence to one accustomed to smell different samples; the odour which remains when the spirit is rubbed on the palm of the hand and allowed slowly to evaporate is also characteristic; the taste of badly rectified spirit is extremely burning and catching to the breath, and when mixed with water it may give a milkiness from the precipitation of some of the higher fatty alcohols. Spirit of wine can be freed from this impurity by careful rectification or by passing it through absorbents, such as charcoal, or by treating it with chemical reagents; but none of these are very successful on the large scale, and the first only by repeated or fractional distillation. The total quantity of fusel oil produced even in large distilleries is but small, and may amount to two or three tenths per cent. of the whole spirit manufactured. Small quantities are converted into the ethers which, under the name of pear essence, &c., are used to flavour confections.

FUSIBLE METAL, a name given to alloys with low melting-points, especially to such as fall below the boiling-point of water. To those mentioned under ALLOY, may be added an alloy which melts at 160° Fahr., and consists of eight parts of bismuth, two of tin, four of lead, and two of cadmium. Rose's fusible metal contains two parts of bismuth, one of lead, and one of tin; it has the peculiarity of expanding up to 111°, and then by further heating it contracts, until at 156° it is densest, and thereafter it expands regularly till it reaches its fusion-point, which is 201° Fahr. Homberg, as early as 1699, used a mixture of equal parts of lead, tin, and bismuth for the injection of anatomical preparations.

FUSILIERS, formerly soldiers armed with a fusil or light flint-lock musket closely resembling a carabine. As all the infantry in the British army are now armed with the same weapon, this is no longer a characteristic appellation, although it is still borne by the following regiments:—the Northumberland Fusiliers (5th), Royal, or City of London Regiment (7th), Lancashire (20th), Royal Scots (21st), Royal Welsh (23rd), Royal Inniskilling (27th), Royal Irish—Princess Victoria's (87th), Royal Munster (101st, 104th), and the Royal Dublin (102nd, 103rd).

FUSING-POINT. Different substances fuse at different temperatures; but the temperature of fusion is always the same for the same substance if it be pure (see, however, for a slight modification of this statement, MELTING-POINT, INFLUENCE OF PRESSURE ON); and this temperature is called the fusing-point of temperature for the substance in question. The following table, taken from Jamin's Cours de Physique, shows the fusing-point for various substances. The temperature of fusion for the substance at the top of the table must be taken as approximate only, owing to the difficulty of determining such high temperatures.

Table of Fusing Points.

Name of Substance.	Fusing-point.	
	Centigrade.	Fahrenheit.
Platinum,	1900°	3452°
English wrought-iron,	1600°	2912°
French soft iron,	1500°	2732°
Steel,	1300 to 1400°	2372 to 2552°
Gold (pure),	1250°	2282°
Copper,	1050°	1922°
Silver (pure),	1000°	1832°
Bronze,	900°	1652°
Antimony,	432°	810°
Zinc,	360°	680°
Lead,	326°	619°
Bismuth,	262°	504°
Tin,	230°	446°
Sulphur,	110°	230°
Iodine,	107°	225°
Selenium,	102°	216°
Alloy—1 part lead, 1 part tin, 4 parts bismuth,	94°	201°
Sodium,	90°	194°
White wax,	69°	156°
Yellow wax,	61°	142°
Potassium,	58°	136°·4
Phosphorus,	43°	109°·4
Olive oil,	5°	41°
Ice,	0°	32°
Essence of turpentine,	−10°	+14°
Bromine,	−25°	−13°
Cyanogen,	−35°	−31°
Mercury,	−39°	−38°·2
Carbonic acid,	−58°	−72°
Ammonia,	−75°	−103°
Nitric Oxide,	−100°	−148°

FUSION, the conversion of a solid body into the liquid state by direct heat, as distinguished from solution, in which the effect is produced by means of a liquid. It is difficult, however, to draw a line between the two, for the main difference is in the temperature, and when a flux is employed all distinction disappears. The term is specially applied to the action of heat on the metals, but it is extended to any solid matter; thus the passage of ice into water at 32° F. is true fusion. The melting of a body generally takes place at a definite temperature, and thus it forms a readily available method of determining its purity. The temperature at which

different bodies melt varies immensely; thus carbonic anhydride and nitrous oxide, which are gaseous at the ordinary temperature, can be converted into solids, of which the melting-points are respectively about 102° and 180° below the melting-point of ice (32° F.), though there are many fluids which have never been solidified at all. Between these low temperatures and the melting-point of ice is the melting-point of mercury, −39° F., while just above the melting-point of ice comes that of the fixed oils: about 150° is the melting-point of the fats and of metallic potassium; the fusion points of the metals then rise regularly from this to above 2700° F., at which iron melts, while above that the fusibility is indicated by the broad statement that the metal becomes liquid or softens in a wind furnace, or is affected only by the oxyhydrogen blowpipe, which is the highest available temperature. There are, of course, bodies like carbon, lime, magnesia, zirconia, and other metallic oxides, which are practically, if not absolutely, infusible even at this temperature, or even in the intense heat of the galvanic battery.

FUSTIAN, a cotton or mixed linen and cotton fabric with a pile like that of velvet but shorter.

FUSTIC. Two dyeing materials pass under this name; one called yellow wood, or old fustic, is the wood of *Morus tinctoria*, dyers' mulberry, a large tree which grows in Cuba, Brazil, Mexico, and parts of North America. The wood is light, of a yellow colour, with orange veins, and contains a resinous insoluble colour, and one soluble in water. A red colour can also be obtained from it. The wood is largely employed for printing and dyeing, as, when mixed with different mordants, it produces a variety of tints. It is used either in the form of powder or of small chips, but the watery extract called fustic liquor, or the same evaporated to a paste or precipitated as a lake, is also in use. With alkalies it gives a deeper yellow, with iron salts a dark green or brown, with logwood a black; but its yellow tint is also heightened by treatment with alum, tin, and other solutions.—The other dye-stuff is distinguished as *young fustic*. It is the wood of *Rhus cotinus*, Venetian sumach, a plant growing in the south of Europe. It also contains a considerable amount of a yellow colouring matter, on which the name *fustin* has been conferred, but its properties require further investigation. It is used in dyeing to produce particular effects, mixed with other colouring matters.

FUSUS, a genus of gasteropodous molluscs nearly allied to *Murex*, with a somewhat spindle-shaped univalve shell. See WHELK.

FUTTIPUR SIKRA (more correctly *Fatehpur Sikri*), a town in Hindustan, in the dist. of Agra, 23 miles W.S.W. of the town of Agra. It was the favourite residence of the Emperor Akbar, who inclosed and fortified it, and the part of the palace containing the apartments of his celebrated prime-minister, Abu-Fazel, is still in good preservation. It is built of dark-red sandstone, in a fine style of oriental Gothic, adorned with numerous pilasters and rich tracery and carvings, and crowned by two domes. In a tomb of elaborate workmanship, standing in the centre of an arcaded square and approached through a noble gate, several members of the royal family were interred. Pop. (1891), 6286.

FYNE, LOCH, an arm of the sea in Scotland, in the county of Argyle. Its entrance in the Firth of Clyde to the north of the island of Arran is formed by the points of Skipness in Kintyre, and Ardlamont in Cowal, from which it stretches first N.N.W. for 16 miles, with a breadth of 4 miles, and then N.E. for 24 miles, with an average breadth of little more than 1 mile. Its depth varies from 12 to 50 fathoms. It abounds with fish, and is particularly celebrated for its herrings, of which vast numbers of the finest quality are annually taken. The scenery in the lower part of the loch is not remarkable, but in the upper part, particularly towards Inveraray, becomes very beautiful and grand.

FYT, JAN, a Dutch painter, was born at Antwerp in March, 1611, and died there on Sept. 11th, 1661. He is known to have visited France and Italy. His subjects were chiefly game, beasts, birds, fruit, flowers, bas-reliefs. He painted much with Rubens, James Jordaens, and Th. Willebort; and his pencil was so prolific, that almost every important collection of paintings has some of his productions. His drawing is highly natural, and yet elegant; his colouring, glowing and vigorous; the colours, especially in the light, laid on richly. In all these qualities he rivals De Voes and Snyders. He was also distinguished for skill in the art of etching. He published, in 1642, two series of representations of animals. David Koning was his scholar.

FYZABAD, or FAIZABAD, a town in British India, in Oude (of which it was at one time the capital), on the right bank of the Gogra, 70 miles E. from Lucknow. Along with the adjacent Ajodha it forms one municipality. It formerly had some splendid buildings, but they are now mostly in decay. There are military cantonments here, and a considerable trade is carried on. It was the scene of one of the outbreaks in the Indian mutiny. Pop. (1901), 74,076.

G.

G, the seventh letter in the English alphabet. If we bend the tongue so as to form an arch, which presses against the roof of the mouth, and produce a sound by breathing and lowering the tongue, the sound is called, in English, *hard g*. If we press the tongue against the roof in the same way, and expire without changing its position, we produce the strong German guttural, as in *ach*, or the Spanish, as in *muger*. If we press the tongue to the roof in the same way, only a little more towards the lips, the guttural is produced, which appears in the German *ich* and *brechen*. If, with the tongue thus situated, we breathe more softly, we produce the German *j*, or the English *y*, as in *yellow*. If we press the point of the tongue against the front part of the roof, and partly against the gum, the sound produced is the English *soft g*, as in *gem*, or the Italian *ge*. This slight difference in the mode of producing these sounds is the reason that the character *g* has been used to express all of them in different languages, and several of them in the same languages. G is nearly connected with C (as in *ca*), from which it originated. The Romans began to use it late, and, therefore, *c* and *g* are often written for each other; for example, *C.* and *Cn.* very frequently stand in place of *G.* and *Gn.* as contractions for *Gaius* and *Gneius*. The sound of *w* or *v* in one language is often represented by a *hard g*, as in *get*, in another; for instance, *Wil-*

liam or *Wilhelm* and *Guillaume* or *Guglielmo*, *Vasco* and *Gascon*; *Welf* and *Guelf*, *Waibling* and *Ghibeline*; and Spaniards, when they are unable to pronounce the English *w*, often use *gu* instead, and say *guee* for *we*. A numerical G was anciently used for 400, and with a dash over it for 40,000. G in music is the nominal of the fifth note in the diatonic scale of C, to which Guido applied the monosyllable *sol*. It is also one of the names of the highest clef.

GABALIS, Comte de, the hero of a French romance of same name, first published at Paris in 1670, the author of which, the Abbé de Villars, born about 1635, was shot in 1673 by one of his relations. In this romance, founded on an Italian original, he exposed the cabala to ridicule. A renowned adept, the Count de Gabalis, is represented as having found in the author capacity to understand the secrets of the cabala, and therefore explains these to him in five conversations. In it is found the theory or doctrine of the four spirits of the elements, which are the Sylphs (spirits of air), the Undines (spirits of water), the Gnomes (spirits of earth), and the Salamanders (spirits of fire). How welcome such a system of elemental spirits or ethereal existences was to the poets whom the Christian religion had deprived of their mythological machinery, without affording an adequate substitute in the fairies and magicians, and how much romantic poetry and fiction have gained by it, is evident. This system was employed by Pope in his Rape of the Lock, by Fouqué in Undine, and by Lord Lytton in Zanoni.

GABELLE, a name originally given in France to every kind of indirect tax, as on wine, cloth, &c., but at a later period specially applied to the tax upon salt. This tax is mentioned in an ordinance of Louis IX., of the date 1246, and was not therefore created, as has been stated by different authorities, either by Philip IV. in 1286 or Philip V. in 1318. An ordinance of Philip VI., dated 20th March, 1340, established a monopoly of salt throughout the kingdom for the benefit of the royal treasury. Officers were appointed to form magazines for salt, and to deal out to each family the quantity which it should consume. The gabelle was at first imposed only temporarily, but Charles V. made it permanent; and this tax, vexatious in its very nature, as well as by the inequality of its incidence and the mode in which it was levied, increased under the subsequent kings. Under Henry II. the provinces of Poitou, Saintonge, Aunis, Angoumois, Gascony, Périgord, La Marche, Limousin, Guienne, and the counties of Foix, Bigorre, and Comminges purchased exemption from this tax for ever by the payment of 1,750,000 livres. These were called the redeemed provinces (*provinces rédimées*). Before 1789 the amount paid for this tax by the inhabitants of different parts of the country varied very greatly, owing to the difference in the amount fixed for consumption by different districts, the difference in the price of a cwt. of salt, and other circumstances. In some districts, for example, the total quantity of salt to be consumed was equal to 25 lbs. per head of the population at 16 livres per cwt., while in others it was equal to 14 lbs. per head, at 21 livres 10 sous per cwt., and in others, again, other rates prevailed. The Constituent Assembly suppressed the gabelle by the law of May 10, 1790. About that time the farmers-general raised by this tax about 38,000,000 livres, of which, at the most, 7,000,000 came into the public treasury.

GABELSBERGER, Franz Xaver, inventor of a system of shorthand, was born at Munich on Feb. 9, 1789, and educated mainly in his native town. Entering the civil service of Bavaria, he became in 1826 secretary to the ministry of the interior, and held that office till his death, which took place at Munich on Jan. 4, 1849. He early turned his attention to stenography, and had long used a system of shorthand invented by himself before he made it public. It was specially adapted to the written character of the German language, and is now used extensively throughout the German Empire, besides being employed to a less extent in some other countries. He published several works relating to his system of stenography. See Gabelsberger's Leben und Streben (Munich, 1868) by Gerber.

GABION, a hollow cylinder formed by planting stakes in the ground in a circle and interweaving them with flexible twigs. In a siege, when forming a trench, a row of gabions is placed on the outside nearest the fortress, and filled with earth as it is thrown from the trench, so as to form a protection against the fire of the besieged. Each gabion is about 20 inches in diameter and 33 inches in height, but this height is usually increased by placing a row of fascines on the top after the interior has been filled up.

GABLE, the triangular end of a house or other building, from the cornice or eaves to the top, and distinguished from a pediment by this, among other things, that it has no cornices, while a pediment has three. The wall of a house which is surmounted by a gable is called the gable-end. In modern towns the gable-ends of houses are usually at right angles to the line of the street, but in the middle ages the reverse was usually the case, the gable-ends being turned towards the street. Many old towns on the Continent are still to be seen with this peculiarity, and some even in Britain. A *gablet* is a small ornamental gable over a buttress, niche, &c. In Scotland, a wall separating two houses, and common to both, is called a mutual gable, and according to Scotch law such a gable is the property of the builder, who can therefore prevent the owner of an adjoining property from using the support of his gable, unless he pays half the cost of erecting it.

GABOON, The, a river, or rather an estuary, on the west coast of Africa, opening into the Gulf of Guinea, on the south of the Bight of Biafra. It is obstructed by a bar, but forms a good harbour, access being obtained through four channels. In length it is about 50 miles and in breadth from 5 to 10. The inhabitants of the adjacent region are a fine race of negroes, who carry on an active trade with Europeans in ivory, copal, ebony, dye-woods, &c. The climate is unhealthy. Near the river spread vast and unwholesome swamps, but inland rise some considerable hills, and these are clothed with dense, jungle-like woods, the abode of the gorilla. This region has been made better known by the travels of M. du Chaillu, Winwood Reade, the Marquis Victor de Compiègne, Dr. Lenz, M. Brazza, &c.; and now belongs to France. The chief settlement on the Gaboon is Libreville.

GABRIEL (a name meaning 'hero of God'), according to the Biblical history, the angel who announced to Zacharias the birth of John, and to Mary the birth of the Saviour; according to Jewish belief, one of the seven archangels who interpreted to the prophet Daniel his dreams. The rabbins say he is the angel of death for the Israelites, and all the souls of that nation are delivered to him by the inferior receivers of spirits, or angels whose sole business it is to receive a certain spirit, and who, after delivering it up, quit the world. According to the Talmud, Gabriel is a prince of fire, who presides over thunder and the ripening of fruits. By the command of Jehovah he set fire to the temple before it could be

burned by the soldiers of Nebuchadnezzar, and the temple uttered its own lament. He once hunted Leviathan, and with the assistance of God conquered him. According to the Mohammedan theology he is one of the four angels peculiarly favoured by the Deity, employed in writing the divine decrees, and the angel of revelation, in which capacity he dictated the whole Koran to Mohammed. He once caught away Mohammed, and transported him so rapidly through the seven heavens that, on his return, he found a vessel yet in the act of falling, which he had overturned on his departure.

GAD (a troop), one of the twelve tribes of Israel, which took its name from Gad, the son of Jacob and Zillah. At the time of the exodus the tribe numbered 45,650 men of twenty years old and upwards; and along with Reuben and Manasseh they had large possessions in sheep and cattle, which led to their ultimate settlement in the land of Gilead, on the east of Jordan, a land which, on account of the excellence of its pasturage, was eminently suited for supporting a population whose chief dependence was upon their flocks and herds. The portion assigned to them lay between that assigned to part of the tribe of Manasseh, which lay to the north, and that assigned to Reuben, which lay on the south. (See Josh. xiii. 24–28.) Ramoth-Gilead, one of the six cities of refuge, was in the territory of this tribe.

GADAMES. See Ghadames.

GADEBUSCH, a town in Mecklenburg-Schwerin, 13 miles W.N.W. of Schwerin. It is walled, and is for the most part poorly built; has an old Gothic church, with a chapel, where King Albrecht of Sweden is buried. The Swedes here gained a brilliant victory over the Danes and Saxons in 1712, and in 1813 Körner the poet fell in the neighbourhood, in the war of Liberation; a monument marks the spot. Pop. (1900), 2130.

GADFLY, a name commonly applied to various insects, a large number of which belong to the great Linnæan genus *Œstrus*, while others belong to the genus *Tabanus*. They are most of them well known, from being among the greatest annoyances to which horses and cattle are subject during the summer. The following are the chief of those belonging to the former genus:—*Œ. boris* or ox gadfly (the *Hypoderma boris* of some naturalists) is about 7 lines in length; thorax yellow, with a black band; abdomen white; terminal segments fulvous; wings dusky. This species attacks the horse also, the female depositing her eggs in the skin of these animals in considerable numbers. In a short time the eggs are matured, and produce a *larva* or worm, which immediately pierces the skin, and insinuating itself under it causes much injury and annoyance to the animal, raising large lumps or tumours filled with pus, upon which the larva feeds. *Œ. equi* (the *Gastrophilus* or *Gastrus equi* of some naturalists) deposits its eggs upon such parts of the skin of horses as are subject to be much licked by the animal, and thus they are conveyed to the stomach, where the heat speedily hatches the larvæ, too well known under the name of *botts*. Horses are sometimes so afflicted by these pests as to die in consequence. The perfect insect is seldom observed, as it lives but a very short time after arriving at the winged state. Taking no nourishment it seeks but to deposit its eggs in a proper situation, and having accomplished this object it immediately dies. The animals which are the subjects of its attacks are instinctively aware of its intentions, and exhibit much restlessness and alarm when they discover it. *Œ. ovis* (also called *Cephalomyia ovis*) deposits its eggs in the nostrils of sheep, where the larva is hatched, and immediately ascends into the frontal sinuses, attaching itself very firmly to the lining membrane by means of two strong hooks situated at its mouth. All the insects of the genus *Œstrus* are thus distinguished by naturalists: haustellum, or trunk, concealed between two tumid lips, which are merely separated by a small orifice; palpi, none; antennæ, short and setaceous. The oviduct, through which the eggs are extruded, consists of a membranaceous, cylindrical tube, furnished with three short, reflected, membranaceous bristles. The pupa is hard and of an oval form, burrowing in the earth and under stones, where it experiences its final tranformation into a winged insect. It has been observed that the larvæ of cutaneous œstri have the mouth furnished with simple papillæ, while those which infest the stomach and frontal sinuses are provided with strong oral hooks, by which they attach themselves very firmly to the membranes. During the months of June and July the pupæ are transformed into the perfect insect. Humboldt states that in South America he observed some Indians whose abdomens were covered with small protuberances, which appeared to have been formed by the larvæ of a species of gadfly. It is also stated that a species exists which, in the larva state, inhabits the frontal sinuses of men. Other species infest the buffalo, camel, stag, &c. Even rhinoceroses and elephants are said not to be altogether exempt from their attacks.

The characteristics of the genus *Tabanus* are two enormous eyes, usually of a greenish-yellow colour, rayed or spotted with purple, antennæ scarcely longer than the head, the last joint with five divisions. The proboscis, almost membranous, incloses a sucker consisting of six small sharp pieces adapted for piercing, with which they suck the blood of horned cattle, horses, and sometimes even of men. They begin to appear in the month of June, buzzing about in woods and pastures. The *T. bovinus*, or large gadfly, is common in Europe, more common in England than in Scotland. It is about an inch in length, brown above, gray below. Its larva lives on the ground, and its metamorphoses take place under the earth, but close to the surface.

GADIDÆ, a family of malacopterous fishes, which includes the cod, ling, haddock, &c. See Cod.

GADOLIN, John, son of Jacob Gadolin—who was an astronomer and professor of physics and theology in the University of Åbo, and latterly bishop—was born at Åbo, June 5, 1760. He studied chemistry under Bergman; between 1786 and 1788 he travelled, and in 1789 was appointed *magister docens*, and, after the death of Gadd in 1797, professor of chemistry in Abo—an office which he held till 1822. He died at Wirmo, in Finland, August 15, 1852. He devoted himself to investigations on mineral and metallurgic subjects, the results of which were published in the Transactions of the Stockholm Academy—of which he was a member—and other journals of the time. The chief of these are on specific heat, on the nature of the metals, and of salts; on the iron in Prussian blue; on the decolorizing power of charcoal; on the impurities in corn spirit; on improvements in distillation; and on the analysis and smelting of iron ores. But the research for which he is specially remembered was upon a black mineral found in the porcelain felspar quarry at Ytterby, near Stockholm, by Arhenius, of which an account had been published in 1788. In 1794 he read a paper to the Academy of Sciences upon it, and showed that it contained a new kind of earth. This discovery was subsequently confirmed by Ekeberg (which see), who called the earth *yttria*, and the mineral *gadolinite*, after its first investigator. The yttria was afterwards shown to be a mixture of several earths.

GADOLINITE. This mineral is a silicate of yttrium, but it always contains a considerable pro-

portion of lime and magnesia, of the oxides of iron, cerium, lanthanum, glucinum, and sometimes of other bases. It occurs imperfectly crystallized in forms belonging to the oblique system, but it is usually found in dull, amorphous masses disseminated through granite. It is black, or very dark green, with a resinous lustre, opaque, breaks readily with conchoidal fracture; specific gravity from 4·097 to 4·3. It is found at Ytterby, and other localities in Sweden, and also in Galway; but it is a rare mineral.

GAELIC LANGUAGE AND LITERATURE. The Gaelic language of the Scottish Highlands belongs to the Celtic branch of the Aryan family. The Celtic languages are arranged in two groups, namely, the Brythonic or Cymric, including Welsh, old Cornish, and Breton; and the Goidelic or Gaelic, including, besides Scottish Gaelic, Irish or Erse, and Manx. Scottish Gaelic is very similar to Irish and Manx, and for centuries the Celts of Scotland and of Ireland used the same literary language. This identity of tongue was due to identity of race, to constant inter-communication between the two countries, and to the existence of a common ecclesiastical organization. Gaelic is now written in the Roman character, with an alphabet of eighteen letters (no *j*, *k*, *q*, *v*, *w*, *x*, *y*, *z*), but Irish is still written in the old characters; and this difference indicates the modernizing tendency of Gaelic scholars as opposed to the conservatism of Irish. A characteristic feature of both languages is the frequent initial aspiration of substantives and other words under certain circumstances; in Gaelic this is indicated by means of the letter *h* (*bean*, a woman, *a'bhean*, the woman), but Irish aspiration is shown by a dot placed over the aspirated consonant. The addition of the *h* in Gaelic, however, materially alters the sound: thus *bh* and *mh* = *v*, *ph* = *f*, *fh* is silent, *sh* and *th* = *h*, &c. Eclipsis, or the softening of initial consonants under certain circumstances, is common in Irish, but rare in Gaelic. The present tense is expressed in Gaelic by a periphrasis, but Irish has a special form as in English. There is no true infinitive. Four cases, Nominative, Genitive, Dative, and Vocative, are recognized, the first being also used as an Accusative. In 1891 the number of persons in Scotland returned as speaking Gaelic only was 43,738, while 210,677 spoke both Gaelic and English; in 1901 the corresponding figures were 28,106 and 202,700. The Gaelic-speaking population is found mostly in Ross and Cromarty, Inverness, Sutherland, Argyle, Perth, Arran, Caithness, and Lanark (incomers from the Highlands).

Gaelic literature is much less ancient and extensive than Irish. The oldest specimens of Gaelic literature extant are the Gaelic portions of the Book of Deer, so called as having originally belonged to the monastery of Deer in Aberdeenshire. It was discovered in 1715, and is now in the Cambridge University library. It dates from about the eleventh century, and consists mainly of a Latin version of the fourth gospel and parts of the other three; but it also contains a Gaelic rubric, and references in Gaelic to matters connected with the monastery. It was edited for the Spalding Club by Dr. Stuart in 1869. The large collection of Gaelic MSS. in the library of the Faculty of Advocates in Edinburgh contains works of various dates from the fourteenth century onwards, and includes lives of saints, homilies and other religious works, translations from the legendary history of Greece and Rome, numerous genealogies and tales of Norse and Irish peoples, a large number of medical and similar works in which the language is skilfully adapted to scientific purposes, lyric poems, &c., but very little in the way of annals or history. The Dean of Lismore's Book, a collection of Gaelic poems made in the early sixteenth century by James Macgregor (d. 1551), Dean of Lismore, clearly shows the development in Scottish Gaelic of the features that distinguish it from Irish. Selections from this book were edited, with translations and notes, by M'Lauchlan and Skene in 1862. The first book printed in Gaelic was John Knox's Liturgy, which was translated by Bishop Carsewell of Argyle and published in 1567. In the seventeenth century, Gaelic literature was enriched by translations of Calvin's Catechism and of the Psalms, and by an edition of Bedell's Irish Bible in Roman letters; and among the poets of this time the most notable are Mary Macleod (1569–1674), known as Mairi Nighean, Alasdair Ruaidh, and John Macdonald (Ian Lom), who wrote satires, warlike odes, and similar poems. In 1725 the Argyll Synod prepared Gaelic versions of the Confession of Faith and the Catechisms, and later in the same century the Bible was translated into Gaelic by Dr. Stewart of Killin, Dr. Stewart of Luss, and others, the Irish Bible having been previously in common use. A Gaelic and English Vocabulary was published in 1741 by Alexander Macdonald (Alasdair Mac Mhaighstir Alasdair), who is also famous as the author of Gaelic Jacobite songs and many fine poems of great tenderness of feeling and beauty of language. Other eighteenth-century poets are: John MacCodrum, the North Uist bard, whose works are mainly political and satirical; Robert Mackay (1714–78), commonly called Rob Donn, a native of Sutherland, who is remembered chiefly by his elegies and satires; Dugald Buchanan (1716–68), a Perthshire poet who published Laoidhibh Spioradail (Spiritual Hymns) in 1767; Duncan Ban Macintyre of Glenorchy (1724–1812), an Argyllshire descriptive poet whose best-known poems are Beinn-dòrain (Ben Doran) and Coire-cheathaich; William Ross (1762–90), a schoolmaster in Gairloch; Allan Macdougall (1750–1829), known as Blind Allan; and the scholarly Ewan Maclachlan (1775–1822), of Old Aberdeen grammar-school, who translated seven books of the Iliad into Gaelic, besides writing original verses in Gaelic as well as in English, Latin, and Greek. William Livingstone (1808–70), the Islay bard, Mary Mackellar (1834–90), Evan MacColl of Canada, John Campbell, and Neil Macleod are among more recent writers of Gaelic poetry. The Rev. Dr. Norman Macleod (1812–72) wrote much in Gaelic, and a collection of his Gaelic writings was published under the title Caraid nan Gaidheal. John Mackenzie's collection, published in 1841 as The Beauties of Gaelic Poetry, is of great importance. The celebrated Ossianic controversy (see OSSIAN) began in the eighteenth century with the publication of James Macpherson's famous work. In this connection J. F. Campbell's Tales of the West Highlands (4 vols., 1860–62) and Leabhar na Féinne (1872) are of great value. Prof. Blackie's Language and Literature of the Scottish Highlands (1876), and Prof. Magnus Maclean's Literature of the Highlands (1904), contain excellent translations from the Gaelic. Of Gaelic grammars we may mention those of Stewart (new edn., 1886) and H. C. Gillies (1896); and of dictionaries those of Armstrong (1825), the Highland Society (1828), M'Alpine (new edn., 1881), and Macleod and Dewar (new edn., 1887). Gaelic poetry continues to be written not only in Scotland, but also in America, and Gaelic periodicals are also published.

GAËTA, a strongly-fortified seaport town of S. Italy, Province of Terra di Lavoro, on the Gulf of

Gaëta, the seat of a bishop, and situated 76 miles south-east of Rome, and 45 miles north-west of Naples. It was anciently called Caieta, and stands upon a promontory of the same name, which, according to Virgil (Æn. vii. 1), has its name from Caieta, the nurse of Æneas. It is a place of great antiquity, and was a favourite resort of the wealthy families of Rome. On the summit of the promontory, inside the new fortifications, stands the huge circular tomb, now called Torre d'Orlando, of Munatius Plancus, a friend of Augustus. The environs of this ancient city are enchanting, and the many pretty villas in the suburbs (the ancient Romans built many country houses here along the fertile coast) render the whole scenery, with its vineyards and olive-gardens, very romantic. After the downfall of Rome, Gaeta fell with the rest of Italy into the hands of the Ostrogoths, at the end of the fifth century, and into those of the Greeks in the middle of the sixth; and when the Lombards almost immediately after made themselves masters of nearly the whole of Italy, it remained, at least nominally, subject to the Byzantine Empire. But it was not long before it became in reality an independent state under its own governors or dukes. It was inclosed by the empire of Charlemagne, but did not belong to it. The Saracens besieged it, without success, about the middle of the ninth century. In the beginning of the twelfth century it was taken by the Normans, and since that date it has shared the fortunes of the Kingdom of Naples. It was taken by the Spaniards in 1734, by the French in January, 1799, and again in July, 1806. In Nov. 1848 Pope Pius IX., being driven from Rome, found an asylum here until he was restored to his seat by the French. In 1861 it was the last refuge of Francis II. of Naples, and had to capitulate to the Italian fleet, the king taking refuge on a French man-of-war. Pop. 19,000.

GÆTULIA, the ancient name of an extensive region of northern Africa, on the southern slope of Mount Atlas, corresponding to the modern Biledulgerid, the southern part of Marocco, and the northern part of the great desert of Sahara. It was inhabited by warlike tribes called the Gætuli, who are supposed to have been representatives of the Berbers, the aboriginal people of northern Africa, and the ancestors of the modern Tuaregs who wander over the oases of Sahara.

GAFF, a spar used in ships to extend the heads of fore-and-aft sails which are not set on stays. The inner end of the gaff forms a sort of fork termed the *jaw*, the outer end is called the *peak*.

GAILLAC, a town of France, in the department of Tarn, on the right bank of the Tarn. It is irregularly built, has a communal college; some coopers-ages, tanneries, dye-works, &c. The district abounds in vineyards. Pop. (1896), 5384.

GAINSBOROUGH, a market town of England, in the county of Lincoln, 15 miles north-west of the town of Lincoln, on the right bank of the Trent, here crossed by a handsome stone bridge of three elliptical arches, and at the junction of the Great Northern with the Great Central and the Great Eastern Railways. The town is supplied with water from an artesian well 1250 feet deep, and another one has also been sunk to a depth of 1508 feet. The parish church is a neat structure of the eighteenth century, with a tower of the fourteenth; and there are besides two other established churches, places of worship belonging to the Roman Catholics, Wesleyans, Congregationalists, &c. Among the public buildings are the town-hall, in the market-place; the Albert Hall; the public hall; the Working Men's Club; and the old hall or manor-house, a quaint building, now containing the rooms of the Literary and Scientific Institute. The Trent is navigable to Gainsborough by vessels of from 150 to 200 tons, and the town has connection by canal with Manchester, Liverpool, Gloucester, Bristol, London, &c. There are ship-building yards, ropewalks, oil-mills, tanneries, breweries, brass and iron foundries, an agricultural implement factory, &c. The malting business is also carried on. Steamers sail between Gainsborough and Hull. The town gives name to a parliamentary division. Pop. in 1881, 10,964; in 1891, 14,372; in 1901, 17,660.

GAINSBOROUGH, THOMAS, a famous English painter, was born at Sudbury, Suffolk, in May, 1727. He was the son of a wool manufacturer, and was educated under his uncle in the grammar-school of his native town. His artistic genius early displayed itself, and for a time he studied art in London under the French engraver Gravelot, and afterwards under Frank Hayman. Returning to Sudbury, he married at the age of nineteen, and soon after removed to Ipswich, where he took pupils and painted landscapes and portraits. In 1760 he took up his residence in Bath, where he soon acquired a leading position as a portrait-painter. He sent pictures to the exhibitions of the Society of Artists from 1761 to 1768, and in the latter year he was elected one of the original members of the Royal Academy. He contributed to the Academy exhibitions during the period 1769–1772, and again, after an interval of estrangement from Sir Joshua Reynolds, from 1777 till 1783. The pictures shown during the first of these periods comprised some landscapes and numerous portraits, among them those of Garrick (two), the Duke of Argyll, and Lord Nugent. Owing to a quarrel with his friend and patron, Philip Thicknesse, he left Bath for London in 1774, and in the metropolis his fame rapidly increased. Among the pictures exhibited at the Academy after his arrival in London none is more celebrated than the Blue Boy (1779), which is said to have been painted to refute a statement made by Sir Joshua Reynolds in one of his discourses. Among portraits painted during this period are those of the Duchess of Devonshire, Duchess of Cumberland, Duke of Argyll, General Conway, Sir Bate Dudley, George III. and his queen, Bishop Hurd, the Prince of Wales, Colonel St. Leger, Lord Cornwallis, the Princess Royal, and other members of the royal family. Owing to a quarrel about the hanging of some pictures he never exhibited at the Academy after 1783. He died of cancer on Aug. 2, 1788. Before his death he was reconciled to Sir Joshua Reynolds. Among his other works the following should be mentioned: portraits of Mrs. Siddons, Hon. Mrs. Graham, Pitt, Blackstone, Johnson, Sterne, Richardson, Clive, Burke, Canning, Franklin, besides others; The Market Cart, The Watering Place, The Brook, Rustic Children, The Cottage Door, Cows in a Meadow, 'Gainsborough's Forest', The Harvest Wagon, Musidora Bathing her Feet, and other fine landscapes. He was of a kindly and generous disposition, but of a somewhat irritable temper. Both in portrait-painting and in landscape-painting he is one of the greatest of English masters. A portrait by him of the Duchess of Devonshire was sold in 1876 for £10,605, and was immediately thereafter stolen, not being recovered till 1901 (in America).

GAIUS, formerly, but less correctly, spelt *Caius*, a learned lawyer of the time of Adrian and Antoninus Pius, of whose life but very little is known. Of his numerous works, his Institutes are particularly important; first, as having been for centuries, down to the time of Justinian, one of the most common manuals of law; secondly, as having been the founda-

tion of the official compendium of the law which occupies an important place in the reform of the judicial system by Justinian; and thirdly, as the only tolerably full, systematic, and well-arranged source of the old Roman law. Some parts of this work had been known for a considerable time. Two leaves of a manuscript of it were discovered in the library of the cathedral chapter at Verona, as early as the beginning of the 18th century, by Scipio Maffei; but the manuscript itself was first discovered in 1816, by Niebuhr, while staying at Verona, on his way to Rome as Prussian ambassador. The parchment on which the Institutes of Gaius were written had been used to copy the letters of St. Jerome. Maffei had perceived it to be a Codex Rescriptus, without, however, having very accurately examined it. Niebuhr saw that an old juridical work lay here concealed, and Von Savigny, professor of law in Berlin, at that time at Paris, happily conjectured that it might be the Institutes of Gaius. The Academy of Sciences at Berlin sent, in 1817, Bekker and Göschen to Italy to investigate this discovery with accuracy. To these two scholars Professor Bethmann-Hollweg offered his services, and by their united efforts the greatest part of the book was brought into order, and with the exception of some illegible passages, wholly restored. In this state it was printed at Berlin (1819–21). The manuscript was again examined by Professor Blume, and many additional discoveries and corrections were made, which were introduced into a new edition (Berlin, 1824). A third greatly improved edition by Lachmann was published in 1842, and others have been published since. The Institutes of Gaius have opened new views upon many points of the history of Roman law, and have also destroyed many acute and learned hypotheses.

GALACTITE, a mineral found in the Campsie Hills, and, along with prehnite, at Bishopton, Scotland. It has got its name from the milky appearance it imparts to water when ground with it. In composition it is identical with natrolite, consisting of silicate of sodium and aluminium with water, and it belongs to the class of Zeolites, sub-group Mesotype.

GALACTOMETER. See LACTOMETER.

GALACTOSE ($C_6H_{12}O_6$), a variety of sugar produced by boiling milk-sugar or lactose ($C_{12}H_{24}O_{12}$) with dilute sulphuric acid. It is sparingly soluble in alcohol, readily in water, from which it crystallizes in transparent prisms. It turns the plane of polarized light to the right, and is readily fermentable. By treatment with nitric acid it yields *mucic* and not *saccharic* acid.

GALACZ. See GALATZ.

GALAGO, or OTOLICNUS, a genus of animals of the lemur family. See LEMUR.

GALANGAL ROOT is obtained from different species of Alpinia growing in the East. What is obtainable in England, though it is not much used in this country, is known as the lesser or Chinese galangal, and is brought from China. It occurs in small pieces, cylindrical and forked, striated and diversified with whitish rings; the outside is brown, the inside paler. It has an aromatic taste and odour, and is an agreeable substitute for ginger in dyspepsia. It yields an oil and a soft resin, but its chemical composition is not settled. The larger or Java galangal is coarser, and is not so strongly aromatic. Other varieties of galangal have been described, such as the light and the Chittagong galangal, but little definite is known about them.

GALAPAGOS (the Spanish for 'tortoises'), a group of islands in the Pacific Ocean, lying about 600 miles west of the coast of Ecuador, to which they belong; area, 2950 square miles. It consists of thirteen islands, six of considerable size, and the others small. The largest, Albemarle, is 60 miles long by 15 broad, and rises in its loftiest summit 4700 feet above the sea. All the islands are of volcanic and comparatively recent origin, and in one of them, Narborough, the volcanic agency is still active. Their appearance from the sea is very uninviting, but in the interior of Charles Island, the sixth of the group in point of size, there is an extensive and fertile plain. The most remarkable animals are a large kind of lizard and elephant tortoises. Charles Island, once used by the Republic of Ecuador as a penal settlement, is now cultivated by colonists.

GALASHIELS, a manufacturing town in Scotland, one of the Hawick district of parliamentary burghs, in the county of Selkirk, on the river Gala, about a mile above its confluence with the Tweed, 27 miles S.S.E. of Edinburgh. It is noted for its manufactures of woollens and in particular tweeds. While the buildings as a whole deserve no particular notice, a marked improvement has taken place of recent years in the principal streets. The town is of rather irregular construction, lying in a narrow valley, and is about 2 miles long. A plentiful water supply was introduced in 1878 at a cost of £50,000. It was one of the first towns in Scotland to adopt the Free Libraries Act. The population increased from 10,312 in 1871 to 16,352 in 1881, and to 17,367 in 1891; in 1901 it was only 13,595.

GALATEA, in classical mythology, daughter of Nereus and Doris. The Cyclops Polyphemus persecuted with his love this charming nymph, though he gained nothing but ridicule in return. The handsome shepherd Acis, of Sicily, enjoyed her affection, and suffered death on her account; for Polyphemus, surprising them in tender embraces, and mad with jealousy, hurled a rock at them, which dashed Acis in pieces, while Galatea escaped into the sea. Acis was transformed into a fountain, and hastened to meet his mistress in a safer region.

GALATIA, the ancient name of an extensive region in Asia Minor, so called from its Gallic inhabitants, who were immigrants from Europe. With the Gauls were intermingled a considerable proportion of Greeks; hence the inhabitants were often called Gallogræci, as well as Galatians.

GALATIANS, EPISTLE TO THE, one of the most important epistles of St. Paul, written probably soon after his second visit to Galatia, recorded in Acts xviii. 23. This is a composition, the genuineness of which has been most generally recognized. As to the time and place of writing the epistle different opinions have prevailed, some maintaining that it is among the very earliest epistles of the apostle, and defending the authenticity of the subscription stating that it was written from Rome, while others hold an equally extreme view that it was among the latest of his epistles. Both of these opinions, however, are now pretty generally regarded as exploded, and the opinion which appears most probable is that the expressions of the epistle in chap. i. 9 and iv. 13–16 point to the second visit of St. Paul to Galatia as a thing of the past, and that this second visit is that recorded as above stated in Acts xviii. 23. Further, the expression 'as soon' in chap. i. 6, seems to warrant the inference that the epistle was written but a short time after this second visit, the conclusion from which is that it was written at the beginning of his protracted stay at Ephesus recorded in Acts xix., or about A.D. 55. The order of events was thus probably as follows:—At his first visit St. Paul experienced a most favourable reception from the Galatians, who exhibited a strong personal attachment to him (Gal. iv. 14). After his departure the judaizing teachers commenced their work, and on the apostle's

second visit he found the noxious influence taking effect. During his short sojourn he endeavoured, by oral instruction, to meet the evil; but learning after his departure to Ephesus that his converts were again lapsing from the faith, he addressed to them this earnest warning. This epistle has been often commented upon. Luther's work on the subject was one of the main instruments of promoting the reformation, and in this point of view still retains its value. Among more modern critical commentaries may be mentioned Winer (Leipzig, 1829), Rückert (Leipzig, 1833), Usteri (Zürich, 1833), Meyer (Göttingen, (1851), Ellicott (London, 1867), Lightfoot (London, 1887), Findlay (1889), and Drummond (1893).

GALATINA, San Pietro in, a town in Italy, in the province of Lecce, and 16 miles west of Otranto. George Castriota, surnamed Scanderbeg, with an army of 15,000, here defeated a tenfold larger army of Turks. Pop. 10,000.

GALATONE, a town in Italy in the province of Lecce, 9 miles N.N.E. of Gallipoli. It contains a castle, and has several convents. Pop, 4877.

GALATZ, or Galacz, a town and port in Roumania, in Moldavia, on the left bank of the Danube, between the confluence of the Sereth and Pruth. It consists partly of an old town, composed of miserable wooden huts huddled together without order, and some newer quarters containing good houses of stone. The principal buildings are several Greek churches, a convent, an hospital, and a large and well-furnished bazaar. The harbour, accessible to vessels of 300 tons, is well frequented, and the chief emporium between Germany and Constantinople. In 1854, during the war with Turkey, Russia blocked up the entrance of the port, which has since been reopened at great expense by a commission of European states. The trade of Galatz was formerly entirely in the hands of the Greeks, but now many English and other foreign houses have established themselves there. The principal exports are grain (principally maize), wine, planks and deals, tallow, petroleum, &c. The imports are chiefly British manufactures, sugar, tin-plates, iron, tar, pitch, coal, oil, olives, dried fruits, lemons and oranges, carobs, tobacco, caviar, salted fish, glass-ware, lamb-skins, leather, and alba or coarse cloth. In 1789 Galatz was taken by the Russians, but was recovered in the same year. On the 11th of Aug., 1791, the preliminaries of peace between Russia and the Porte were signed here. A battle took place in the neighbourhood between the Hetærists and the Turks in 1821, and in 1828 another between the Russians and the Turks, in which the latter were defeated. In 1834 Galatz was made a free port, and it continued to hold this position till 1883. After being made a free port its population rapidly increased, and the increase has still continued; from 36,000 in 1869 it rose to be 62,678 in 1899.

GALAXY (*Via Lactea*, or Milky Way), in astronomy, that long, luminous track or zone which encompasses the heavens, forming nearly a great circle of the celestial sphere. It is inclined to the plane of the ecliptic at about an angle of 60°, and cuts it nearly at the two solstitial points. It traverses the constellations Cassiopeia, Perseus, Auriga, Orion, Gemini, Canis Major, and the Ship, where it appears most brilliant in southern latitudes; it then passes through the feet of the Centaur, the Cross, the southern Triangle, and returns towards the north by the Altar, the tail of the Scorpion, and the arc of Sagittarius, where it divides into two branches, passing through Aquila, Sagitta, the Swan, Serpentarius, the head of Cepheus, and returns into Cassiopeia. The ancients had many singular ideas as to the cause of this phenomenon; but modern astronomers have long attributed it to a great assemblage of stars; and the investigations of Sir William Herschel, and subsequently those of his son Sir John Herschel, have confirmed these conjectures. Sir William Herschel's telescope showed him, in a space of about 15° long by 2° broad, no less than 50,000 stars. This, however, instead of satisfying the curiosity of astronomers, only gave rise to further inquiries and hypotheses. The hypothesis of Sir Wm. Herschel himself is the most important and the most satisfactory. He supposes the sidereal universe to be distributed into nebulæ and clusters of stars, and the Milky Way to be that particular cluster in which our sun is placed. In a paper on the construction of the heavens, Herschel says it is very probable that the great stratum called the *Milky Way* is that in which the sun is placed, though perhaps not in the centre of its thickness, but not far from the place where some smaller stratum branches from it. Such a supposition will satisfactorily, and with great simplicity, account for all the phenomena of the Milky Way, which, according to this hypothesis, is no other than the appearance of the projection of the stars contained in this stratum and its secondary branch. Herschel says that in the most crowded part of the Milky Way he has had fields of view that contained no less than 588 stars, and these were continued for many minutes, so that in a quarter of an hour he had seen 116,000 stars pass through the field of view of a telescope of only 15′ aperture; and at another time, in forty-one minutes, he saw 258,000 stars pass through the field of his telescope. The first photographs of the Milky Way were obtained by Prof. Barnard in 1889.

GALBA, Servius Sulpicius, successor of Nero, born B.C. 3, of the ancient and celebrated family of the Sulpicii. He was made prætor (A.D. 20) before he had reached the lawful age, and afterwards governor of Aquitania. In A.D. 33 he was raised to the consulship through the influence of Livia Drusilla, the wife of Augustus. Caligula appointed him general in Germany. He soon repulsed the Germans who had invaded Gaul, and restored the ancient military discipline. After the death of Caligula he caused his troops to swear allegiance to Claudius, who received him for this service among his most confidential friends, and sent him in A.D. 45 as proconsul to Africa, where great confusion prevailed. In two years Galba restored order, obtained the honours of a triumph, and was received among the priests of Augustus. He lived afterwards in retirement till the middle of Nero's reign that he might avoid exciting suspicion. Nero appointed him in A.D. 61 governor of Hispania Tarraconensis, but soon after became so exasperated against him that he ordered him to be secretly assassinated. Galba then revolted against the emperor, but became involved in great difficulties, when news arrived of the insurrection among the prætorians at Rome, and of the death of Nero (A.D. 68), and he himself was chosen emperor by the prætorian cohorts in Rome. Ambassadors from the senate made known to him his elevation. He went directly to Rome, and caused several insurgents to be executed. By this act as well as by his indulgence to his friends, whom he suffered to rule him absolutely, and by his excessive avarice, he excited universal displeasure. Scarcely had he entered upon his second consulship when the legions in Upper Germany revolted against him. This induced him to choose a colleague in the government under the name of an adopted son. Instead of Otho, who was favoured by the soldiery, he selected Piso Licinianus, who was hated by them on account of his rigid virtue. Otho, offended by this neglect, resolved to get possession of the throne by force of arms. The prætorian cohorts first declared themselves in his favour, and Galba, attempting in vain to restore order, was

attacked and slain in the beginning of A.D. 69. He was seventy-two years old, and had reigned three months.

GALBANUM has been used medically and for incense from the earliest times, but there is still doubt as to the plant from which it is obtained. Most probably it is derived from the umbelliferous *Ferula galbaniflua*, a native of Persia, but other species of the same genus may also yield it. The galbanum of commerce is a gum-resin, in large, soft, ductile, unctuous masses, of a whitish yellow or brown colour, and possessing an acrid, bitter taste, with a strong disagreeable odour, and containing little fragments of leaves and stems. These are separated by melting the resin and straining it through a cloth. At a low temperature it is brittle. When mixed with water it forms a yellow emulsion; it is partially dissolved by alcohol, insoluble in oil of turpentine. It consists of 6 per cent. ethereal oil, 67 resin, 19 gum, 8 of foreign matters. The oil is obtained by distilling with water. It is colourless, boils at 320° Fah., and has a specific gravity of 0·884. It is said to have the same composition as oil of turpentine. The resin, extracted by spirit, is dark yellow, transparent, brittle, and tasteless, and fuses at about 212°. When heated to about 250° or 260° Fah. it yields a blue-coloured oil, soluble in alcohol, and crystals of *umbelliferone*. A resin is also got by digesting galbanum in milk of lime, and adding acid to the alkaline solution, when a white or yellowish flocky resin is precipitated. In its medical properties it is intermediate between ammoniac and asafœtida, which are likewise the products of plants of the same natural order. At present it is rarely used, but in combination with other articles it forms some officinal preparations.

GALE, or SWEET GALE. See CANDLEBERRY.

GALEN, CHRISTOPH BERNHARD VON, the warlike bishop of Munster, of an ancient family of Westphalia, was born at Bispink, in Westphalia, on Oct. 15, 1600. He was educated in a Jesuit college at Münster, and at the universities of Cologne, Mayence, &c. In 1650 he was chosen Prince-bishop of Münster, which he immediately began to govern with vigour. The inhabitants, however, did not readily submit to his rule. In 1657 he was obliged to besiege the city, and when it submitted to him on the 6th of August, 1661, he built a citadel in it in order to hold the citizens in subjection. In 1664 he was appointed one of the leaders of the imperial army against the Turks in Hungary. In the following year he took up arms for England against the Dutch, and gained many advantages over them. Peace was concluded in 1666 by the mediation of Louis XIV. In 1672 the war broke out anew in consequence of the Dutch withholding from him a portion of his territory. In alliance with France he took from the Dutch States several cities and strongholds. The emperor having compelled him to conclude a peace, he united himself with Denmark against Sweden, and obtained by conquest the Duchy of Bremen and other places. He died September 19, 1678. He was a man of extraordinary enterprise, one of the greatest generals of his time, as well as an adroit diplomatist.

GALEN, CLAUDIUS, a Greek physician, born A.D. 130, at Pergamus in Asia Minor. His father, Nicon, an able architect and mathematician, gave him a careful education, and destined him to the study of medicine. After having enjoyed the instructions of several renowned physicians in Smyrna, Corinth, and Alexandria and other places, mention of which is made in his works, Galen visited Cilicia, Phœnicia, and Palestine. He returned to Pergamus, his native city, at the age of twenty-eight, where he received a public appointment. A sedition induced him, when thirty-three years of age, to go to Rome, where he acquired great celebrity by his successful cures, and by his skill in prognostics. He also drew upon himself the envy of the other physicians to such a degree that he was obliged to give up the delivery of his anatomical lectures, and finally to go to Asia just at the time that a contagious disease broke out in Rome. He travelled through various countries to investigate the most remarkable productions of nature and different medicines, and soon after he had begun to resume his ordinary course of life at Pergamus he was invited to Aquileia by the Emperors Marcus Aurelius and Lucius Verus. He at once repaired thither, and arrived about the end of A.D. 169, not long before a pestilence broke out in the camp of the emperors. Marcus Aurelius and Lucius Verus, immediately on the outbreak of the pestilence, set out for Rome, and on his way thither the latter died of apoplexy. Galen followed Marcus Aurelius soon after; and it seems to have been about this time that he was commissioned by the emperor to prepare for him the celebrated medicine called *Theriaca*, of which he was accustomed to take a little every day. It not known how long Galen stayed at Rome on this occasion; but it is probable that he remained for some years lecturing, writing, and practising. He seems afterwards to have returned to Pergamus, but of the subsequent events of his life little is known. It is not known when or where he died. One Arabic writer says that he died in Sicily, and Suidas states that he died at the age of seventy, and accordingly in the year A.D. 200 or 201; but it is not improbable that, as some authorities state, he lived several years longer. Galen had great merit as a physician and philosopher, especially by completing the empirical pathology, and laying the foundation for a just theory of sensation, and the peculiar animal functions of the body. His writings give evidence of deep reflection, as well as an historical knowledge of the old Greek systems of philosophy, and extend to every department of medicine. Numerous as those extant are, we have now only a part of his productions, for many were burned when his house in Rome was consumed. The writings attributed to Galen include eighty-three treatises acknowledged to be genuine, forty-five manifestly spurious; nineteen of doubtful genuineness, and fifteen commentaries on different works of Hippocrates, besides a large number of short pieces and fragments, probably in great part spurious. Of his lost works, fifty medical and 118 mostly philosophical, are mentioned in the Bibliotheca of Fabricius. The oldest and most complete edition, in Greek only, is the Aldine, 1525, folio, which was followed by the Greek edition of Basel, 1538, folio, and the Græco-Latin one in thirteen folio vols., by Ren. Chartier, with the works of Hippocrates added (Paris, 1679). In 1819 Dr. Kühn of Leipzig undertook a new edition in Greek and Latin (twenty vols. 1821–33). A useful translation of various anatomical, physiological, and medical works of Galen is that of Daremberg in French (Paris, vols. i. and ii. 1854–56).

GALENA (Pb S), the sulphide of lead, found both in masses and crystallized in cubes, but sometimes in truncated octahedra; its colour is bluish gray, like lead, but brighter; lustre, metallic; texture, foliated; fragments, cubical; soft, but brittle; specific gravity, 7·22 to 7·759; effervesces with nitric and hydrochloric acids. By the action of strong nitric acid sulphate of lead is produced. Before the blowpipe it usually decrepitates, and on charcoal is decomposed and melted, yielding a globule of metallic lead. It contains 86·6 per cent. of lead and 13·4 of sulphur, generally some silver, and also antimony, zinc, iron, and bismuth, giving rise to the minerals called steinmannite and plagionite, &c. Sometimes the silver is

in the proportion of 10, 20, 40, or even more than 100 ounces to a ton of the ore. It is then worked as an ore of silver, and called *argentiferous galena*. The varieties containing the most silver do not possess the highest lustre, nor the palest colour. In fact they are sometimes blackish-gray. Some varieties of the ore do not yield more than 50 or 60 per cent of lead. Galena occurs in primitive and transition mountains, but is more frequently found in secondary rocks, especially in compact limestone. Its beds sometimes alternate with shell limestone, and it is accompanied by blende, pyrites, quartz, heavy-spar, fluor-spar, calcite, and minerals arising from the decomposition of the ore itself. It occurs in many countries, and in England it is tolerably abundant. It is widely dispersed over the United States of America, the chief galena-producing localities being Colorado, Utah, the upper Mississippi and southern Missouri valleys, some of the New England states, &c. The produce of all the lead mines of the United Kingdom in 1898 amounted to about 32,985 tons of ore, yielding 25,355 tons of lead, value £332,995. See LEAD.

GALENA, a town of the United States, capital of Jo Daviess Co., Illinois, near the borders of Wisconsin, in the great lead region, situated on both sides of the Fevre (or Galena) river, 6 miles above its junction with the Mississippi. The chief industrial establishments are large flour and saw mills, iron-foundries, breweries, lumber-yards, &c.; but the great staple is lead, which is extensively worked here. Pop. (1890), 5635; (1900), 5005.

GALENISTS. See ANABAPTISTS.

GALERIUS, a Roman emperor. See MAXIMIANUS.

GALESBURG, a city of the United States, capital of Knox Co., Illinois, and about 50 miles W.N.W. of Peoria. It is the centre of a large agricultural region, and has iron-foundries, railroad workshops, manufactures of agricultural implements, &c. It is here that Knox College, St. Joseph's Academy, and Lombard University are situated. Pop. (1880), 11,437; (1890), 15,264; (1900), 18,607.

GALIANI, FERDINANDO, an Italian abbé, celebrated for his wit and writings, was born in the year 1728 at Chieti. A humorous collection of verses on the death of the public executioner first made him known as a writer. This was followed in 1750 by his celebrated work Trattata della Moneta (Treatise on Money). He soon after, by the desire of Pope Benedict XIV., undertook a collection of specimens of the various matters thrown up by Mount Vesuvius, a catalogue of which was published in 1772. This collection he sent to the pope, and on one of the boxes was inscribed *Beatissime pater, facut lapides isti panes fiant* (Most blessed father, cause these stones to become bread); the pope took the hint, and gave him a living of 400 ducats per annum. In 1759 he was appointed secretary to the French embassy, and soon took a leading part among the wits and eminent men of Paris, among them Grimm and Diderot, by whom he was introduced to Madame d'Épinay and Baron Holbach. During his residence in France he composed a Commentaire sur Horace, and Dialogues sur le Commerce des Blés, written in opposition to the policy of the free exportation of corn, then recently adopted with a view to encourage agriculture. On his return to Naples in 1779 he kept up a correspondence with Madame d'Épinay, and his letters to her were published in two vols. in 1818. He died, loaded with honours and offices, and possessed of very general esteem, on the 30th October, 1787.

GALICIA (Polish, *Halicz*; German, *Galizien*), a province of Austria, composed of the kingdoms of Galicia and Lodomeria, the duchies of Auschwitz and Zator, and the grand-duchy of Cracow, and formerly including the duchy of Bukowina. It is bounded on the N., N.E., and E. by Russia, S.E. by Bukowina, S. by Hungary, and W. by Moravia and a small portion of Prussian Silesia; area, 30,307 square miles; pop. (1900), 7,295,538. The great physical features of the country are, in a manner, determined by the Carpathians, which form a long and irregular curve on the south, the convexity being towards Galicia. The north side of the chain is more abrupt than the south, and the branches which proceed from it stretch for a considerable distance into Galicia. Farther to the north the hills subside rapidly, and finally merge into vast plains. Galicia is partly traversed by the great watershed which divides the whole continent of Europe into great basins. The chief river in the north-west is the Vistula, which partly bounds the province. The Western Bug, a tributary of the Vistula, is partly in Galicia. The chief river is the Dniester. The only part of the surface belonging to the basin of the Danube is in the south-east. It is drained by the Pruth, and is of very limited extent. The climate is severe, particularly in the south, where more than one of the Carpathian summits are beyond the limit of perpetual snow. While Galicia is open to the cold north and east winds, these mountains intercept the warm winds from the south. The isothermal line of Lemberg, nearly in the same latitude as Paris, is only 50°, the very same as that which passes nearly through the centre of England. The extremes of temperature are great. The winters are long and severe, and the summers very warm, but comparatively short. Deep snow is not uncommon in the middle of April.

The soil is much diversified. In the more mountainous districts it often forms a thin covering on bleak and almost barren rocks, where scanty pasture only is obtained. In other parts of the same district both the quality and the depth of the soil improve, the pastures become excellent, and many magnificent forests occur. In parts of the north and west the soil is of a sandy nature, and the crops are very indifferent; but in general, where the elevation is small, the ground, more especially where resting on a substratum of limestone, is of great fertility, and yields abundant crops of wheat, rye, barley, oats, and maize. Hemp, flax, and tobacco are also extensively grown, and the sugar beet is cultivated. The domestic animals include great numbers of horned cattle, generally of a superior description, and a fine hardy breed of horses, well adapted for cavalry. Sheep are in general very much neglected; but goats, swine, and poultry abound. The rearing of bees is much attended to, and produces great quantities of wax and honey. Bears and wolves are frequently met with in the forests, and all the lesser kinds of game are in abundance. The minerals include marble, alabaster, copper, lead, zinc, calamine, coal, iron, and rock-salt. Only the last two are of much importance. Iron occurs in numerous parts of the central Carpathian chain, and bog-iron ore is frequently met with in extensive seams on the plains. They are both worked to a considerable extent. Rock-salt is particularly abundant, stretching in continuous beds for nearly 250 miles along the base of the Carpathians, and of course beyond the limits of Galicia, into Bukowina and Transylvania. The most important mines have their central locality at Wieliczka. Manufactures have not made much progress. The spinning and weaving of flax and hemp prevail to a considerable extent on the confines of Silesia. Distilleries exist in every quarter. Tobacco, sugar, leather, beer, agricultural machinery, &c., are also manufactured. The principal exports are salt, wood, grain, coal, aniseed, linen, and spirits. The population is generally of Slavonian origin, and consists of two principal branches—Polish in the

west and Russniak in the east. A Roman Catholic, Greek Catholic, and an Armenian archbishop residing at Lemberg, along with the evangelical superintendents at the same place, are at the head of the church affairs in Galicia. Besides these there are three Roman Catholic bishops and one bishop of the Greek Church in separate dioceses. The number of the Jews is considerable. The Karaite (or non-Talmudic) Jews in the East, although few in number, are yet remarkable on account of some peculiarities of belief and observance which they preserve. The court of third instance for the country is the superior court at Vienna; there are two courts of second instance, one at Lemberg and the other at Cracow; and there are various district courts of first instance. The government has its head-quarters at Lemberg. Educational establishments, both for superior and ordinary instruction, are numerous. At the head of the former stand the university of Cracow, with about 130 instructors and some 1300 students, and the younger university of Lemberg, with 80 instructors and a similar attendance. The principal towns are Lemberg, the capital, Brody, Cracow, Stanislau, Tarnopol, Przemysl, Sambor, &c.

The nucleus of the modern Kingdom of Galicia and Lodomeria was formed by the Duchies of Halicz and Vladimir (the original forms of the present names), which were established about the beginning of the twelfth century under two princes of the Russian dynasty of Rurik. These two duchies sometimes maintained an independent existence, and were sometimes united under one ruler, and the continual contests between the different branches of the family which possessed them gave frequent occasion for the interference of the Poles and Hungarians. After the beginning of the thirteenth century they were almost a constant theatre of war between Russians, Poles, and Hungarians, and the native rulers were obliged to recognize the supremacy sometimes of the one and sometimes of the other. Louis the Great, who reigned over the united kingdoms of Poland and Hungary in the second half of the fourteenth century, considered Galicia as attached to his Hungarian crown; but after his death Vladislav Jagello succeeded in conquering it for Poland, with which country it remained connected until the first partition of Poland, in 1772. On this occasion Galicia, with the addition of some additional fragments of Poland, fell to Austria, under the name of the Kingdom of Galicia and Lodomeria, to which, in 1786, Bukowina (which had been acquired by Austria from the Porte in 1775, in return for its mediation in the Russo-Turkish war) was added. When Austria, on the occasion of the last partition of Poland in 1795, made new acquisitions of territory, these last received the name of West or New Galicia, while the previously acquired territories were named East or Old Galicia. In the Peace of Vienna in 1809 Austria was compelled to cede to Napoleon the whole of West Galicia, along with Cracow and a section of East Galicia, in order to be united to the Grand-duchy of Warsaw. In 1846 Cracow, which had been erected by the Congress of Vienna into an independent duchy under the protection of Austria, Russia, and Prussia, was by an agreement among the three protecting powers re-united to Austria, and in 1849 was declared to be a component part of Galicia with the title of a grand-duchy, while Bukowina was separated from Galicia and erected into a separate crown-land. The constitution of Galicia is based upon the imperial diploma of October 20, 1860, and the decree or patent of February 26, 1861, as finally established in 1867. According to this Galicia is one of the Cis-Leithan provinces of the Austrian Empire, and as such is represented in the *Reichsrath*, while the affairs peculiar to itself are deliberated and determined upon by its own *Landtag*. The modification of this constitution, however, in the direction of increased autonomy has ever since been the aim of the national party, and an important step in this direction was taken when the Polish language was introduced as the language of official intercourse, and that in which instruction is given in the higher educational institutions. See AUSTRIA.

GALICIA, one of the old provinces of Spain, situated in the N.W., and bounded N. and W. by the Atlantic, S. by Portugal, and E. by the old provinces of Asturias and Leon. It is now divided into the provinces of Coruña, Lugo, Orense, and Pontevedra. The area is 11,212 square miles, and the pop. in 1897, 1,941,023. Its coast, which has a length of about 240 miles, lies open to the Atlantic, and is much more broken and indented than that of any other part of Spain, almost every stream, however small, emptying itself into a considerable estuary. In this way a number of fine natural harbours have been formed, one of which, Ferrol, in which nature has been greatly aided by art, forms one of the finest naval ports in Europe. The surface is very mountainous, being traversed by numerous branches of the Cantabrian chain. The proportion of good arable land is very limited. In the more elevated districts the soil is generally thin, and of little natural fertility. In the lower grounds it is often of a calcareous texture, and yields good crops. The grain raised, however, falls considerably short of the consumption. Besides corn, considerable quantities of maize, hemp, flax, and potatoes are grown. Fruit, particularly apples and pears, nuts, walnuts, and chestnuts are very abundant. Oranges and citrons grow well only in the south and more sheltered spots. There, too, the best wine is produced, though the culture of the vine is common in all the lower districts of the kingdom. The higher mountain slopes are generally covered with forests, which grow excellent timber, feed large herds of swine, of which excellent hams and bacon are made, and afford haunts to boars and wolves, as well as shelter to many varieties of smaller game. The minerals include silver, lead, copper, iron, marble, and jasper; but they are almost entirely neglected. Both manufactures and trade are insignificant. The chief town is Santiago de Compostela. The natives speak an uncouth patois, which other Spaniards scarcely understand. The modern Galicia represents a part of the ancient Callæcia, the inhabitants of which, Callaici or Gallæci, are the ancestors of the modern Galicians, or as they call themselves, Gallegos. They were a brave and warlike people, who long maintained their independence against the Romans, and were not completely subdued till the time of Augustus. In the beginning of the fifth century it was conquered by the Suevi, who maintained themselves here till 585, when their kingdom was destroyed by the Visigoths. On the occasion of the Arab conquest of Spain at the beginning of the eighth century, the Galicians refused to own allegiance either to the Saracen conquerors or to the petty kings of the Asturias; and when the efforts of the latter at the end of the eighth century were successful in imposing counts upon them to defend and administer the cities, these counts soon began to aspire to independence, which they gradually attained. The nobles preserved immense power in this region till towards the end of the fifteenth century, and carried on a system of the most abominable brigandage; but at that time Ferdinand the Catholic sent a regiment of cavalry into the province, which destroyed forty-six fortresses, and forced to flee or delivered up to punishment all those who had been guilty of outrages.

GALILEE, the name applied to a portico or chapel annexed to a church, and used as a place where public penitents were stationed, dead bodies deposited previously to their interment, religious processions formed, and, in some religious houses, where monks were allowed to converse with their female relatives.

GALILEE, in the time of our Saviour the most northern division of Palestine, bounded on the E. by the Jordan and lakes Merom and Tiberias (Sea of Galilee), on the S. by Samaria, on the W. by Phœnicia, and on the N. by the Mountains of Lebanon and Hermon. It was divided into Upper and Lower Galilee, and was on the whole a fertile and thickly-peopled region, with many towns and villages. The plain of Esdraelon was generally reckoned as part of it, and in the south-west it reached the Mediterranean at Mount Carmel. As the cradle of Christianity this small country has a general interest. Here lay Nazareth, in which Jesus was brought up; here he began his ministry and collected together his disciples; here was Cana, where he performed his first miracle; and Capernaum, on the Lake of Tiberias, which often saw him within its walls; and Nain, where he raised the young man to life; here lay the hill on which he delivered the sermon on the mount; here was Mount Tabor, where his disciples saw him in his transfiguration. The inhabitants, on account of their ignorance and simplicity of manners, were despised by the other Jews, who, by way of contempt, called Christians, at first, *Galileans*. At present Galilee is included in Syria, and is thus part of the Turkish dominions.

GALILEI, GALILEO, who has gained immortality by his discoveries in natural philosophy, was born in February, 1564, at Pisa. His father, Vincenzo Galilei, a nobleman of Florence, caused him to be instructed in the ancient languages, drawing, and music, and he very early showed a strong inclination to mechanical labours. In 1581 Galileo entered the University of Pisa, to attend lectures on medicine and the Aristotelian philosophy. The latter, loaded with scholastic rubbish, even then disgusted him, and he afterwards became its declared adversary. That spirit of observation for which he was distinguished was early developed. When only nineteen years old the swinging of a lamp suspended from the ceiling of the cathedral in Pisa led him to investigate the laws of the oscillation of the pendulum, which he was the first to apply as a measure of time. He studied mathematics under Ostilio Ricci, soon exhausted Euclid and Archimedes, and was led, by the works of the latter, in 1586, to the invention of the hydrostatic balance.

He now devoted his attention exclusively to mathematics and natural science, and in 1589 he was made professor of mathematics in the University of Pisa. He was constantly engaged in asserting the laws of nature against a perverted philosophy, for which he is now extolled as the father of modern physics, but then suffered the severest persecutions. In the presence of numerous spectators he went through with his experiments, which he performed on the tower of the cathedral, to show that weight has no influence on the velocity of falling bodies. By this means he excited the opposition of the adherents of Aristotle to such a degree, that after two years he was forced to resign his professorship. He retired to the house of Filippo Salviati, where he became acquainted with Francesco Sagredo, a worthy Venetian, upon whose recommendation the senate of Venice, in 1592, appointed him professor of mathematics in Padua. He lectured here with unparalleled success. Scholars from the most distant regions of Europe crowded about him. He delivered his lectures in the Italian language, which had not been previously used for science. In 1597 he invented the sector.

One of the most important mathematical discoveries which he made at a period subsequent to this is that the spaces through which a body falls, in equal times, increase as the numbers 1, 3, 5, 7; that is, if a body falls 16 feet in the first second, it will fall 48 in the second second, 80 in the third, and so on. Whether the thermometer was his invention it is difficult to determine; perhaps he only improved it. He made some interesting observations on the magnet. The telescope, which in Holland remained not only imperfect but useless, Galileo turned to the heavens, and in a short time made a series of the most important discoveries. He found that the moon, like the earth, has an uneven surface; and he taught his scholars to measure the height of its mountains by their shadow. A particular nebula he resolved into individual stars, and even conjectured that the whole Milky Way, with good instruments, might be resolved in the same manner. His most remarkable discovery was that of Jupiter's satellites, January 7, 1610. He likewise observed Saturn's ring, though he had not a just idea with regard to it. He saw the sun's spots somewhat later, and inferred, from their regular advance from east to west, the rotation of the sun, and the inclination of its axis to the plane of the ecliptic.

Galileo's name, meantime, had grown so celebrated that Cosmo II., grand-duke of Tuscany, appointed him grand-ducal mathematician and philosopher, and invited him to become first instructor in mathematics at Pisa, where, however, he was not obliged to reside. He lived sometimes in Florence, and sometimes at the country seat, *Alle Selve*, of his friend Salviata. Here he gained a decisive victory for the Copernican system by the discovery of the varying phases of Mercury, Venus, and Mars; as the motion of these planets about the sun, and their dependence on it for light, were thus established beyond the possibility of doubt. He wrote a work afterwards on the floating and sinking of solid bodies in water, and in this, as well as in all his other writings, he has scattered the seeds of many new doctrines.

While he was thus employed in enlarging the field of natural philosophy, a tremendous storm was gathering about his own head. He had declared himself in favour of the Copernican system, in his work on the sun's spots, and was therefore denounced as a heretic by his enemies. In 1611 he visited Rome for the first time, where he was honourably received, and where a favourable report was made on his writings by the mathematicians of the Collegio Romano at the instance of Cardinal Bellarmin. On his return to Florence, however, he became more and more involved in controversy, which gradually took a theological turn, and in the course of which he declared the literal understanding of the utterances of Scripture with regard to physical phenomena to lead to absurdities. From Rome he received, in the name of the Cardinal Barberini (afterwards Pope Urban VIII.), the warning not to overstep the limits of mathematics and physics, but he paid no heed to the well-meant advice. The monks preached against him, and in 1616 he found himself again obliged to proceed to Rome, where he is said to have pledged himself to abstain for the future from promulgating his system either orally or otherwise. The genuineness of the document on the basis of which this is asserted, has, however, been questioned in modern times, and the controversy regarding this matter is not yet finally settled.

In 1618 the appearance of three comets gave him an opportunity to communicate to his friends some general observations on these bodies. His scholar,

Mario Guiducci, wrote a work immediately after, in which he severely condemned the Jesuit Grassi. Supposing Galileo to be the author, Grassi attacked him. Galileo replied in his Saggiatore, a masterpiece of eloquence, pronounced by Algarotti to be the finest controversial work Italy has ever produced, and, notwithstanding the errors contained in it, a work always worthy to be read. This drew upon him the fury of the Jesuits.

About this time he completed his famous work, in which, without giving his own opinion, he introduces three persons in a dialogue, of whom the first defends the Copernican system, the second the Ptolemaic, while the third appears as a blind and unreasoning supporter of the views of Aristotle. With this immortal work, in which the greatest elegance and accuracy of style is united with the clearest and most concise statements, Galileo went to Rome in 1630, and succeeded in obtaining the privilege to print it. Having obtained the same permission in Florence, he published it there in 1632—Dialogo di Galileo Galilei, dove ne' Congressi di quattro Giornate si discorre de' due massimi Sistemi, Tolemaico et Copernicano. Scarcely had it appeared when it was attacked by the disciples of Aristotle, and most violently of all by Scipione Chiaramonti, teacher of philosophy at Pisa. Urban VIII., who, when a private man, had been the friend and admirer of Galileo, now became his severest persecutor. The monks had persuaded him that Galileo, in the person of Simplicio, the Aristotelian advocate, had intended to ridicule his folly in suffering so offensive a book to be printed. It was no difficult task for his adversaries to inflict upon Galileo the severest treatment, especially as his patron, Cosmo II., was dead, and the government of Florence was in the feeble hands of the young Ferdinand II. A congregation of cardinals, monks, and mathematicians, all sworn enemies of Galileo, examined his work, condemned it as highly dangerous, and summoned him before the tribunal of the Inquisition. The veteran philosopher was compelled to go to Rome early in 1633, and in June, 1633, was condemned to renounce, in presence of an assembly of ignorant monks, kneeling before them, with his hand upon the Gospel, the great truths he had maintained. 'Corde sincero et fide non ficta, abjuro, maledico et detestor supradictos errores et hereses,' was the formula which he was compelled to pronounce. At the moment when he arose, indignant at having sworn in violation of his firm conviction, he is said (but this is doubtful) to have exclaimed, in an undertone, stamping his foot, 'E pur si muove' (and yet it moves!). Upon this he was sentenced to the dungeons of the Inquisition for an indefinite time, and every week, for three years, was to repeat the seven penitential psalms of David. His Dialogo was prohibited, and his system condemned as contrary to the Bible. It is still a matter of controversy whether Galileo was subjected to torture on this occasion or not. Certain documents published in recent times seem to imply that he was merely menaced with torture, but the genuineness of these documents also is denied by some of Galileo's champions. His judges were merciful enough to commute his sentence of imprisonment to banishment to the villa of the Grand-duke of Tuscany at Rome, then to the archiepiscopal palace at Sienna, and soon after he was allowed to return to Arcetri, not far from Florence.

He employed his last years here principally in the study of mechanics and projectiles. The results are found in two important works on the laws of motion, the foundation of the present system of physics and astronomy. At the same time he tried to make use of Jupiter's satellites for the calculation of longitudes; and though he brought nothing to perfection in this branch, he was the first who reflected systematically on such a method of fixing geographical longitudes. He was at this time afflicted with a disease in his eyes, one of which was wholly blind, and the other almost useless, when, in 1637, he discovered the libration of the moon. Blindness, deafness, want of sleep, and pain in his limbs united to embitter the last years of Galileo's life. He died on the 8th or 9th of Jan. 1642 (the year Newton was born). His relics were ultimately deposited in the church of Sta. Croce, at Florence, where a splendid monument was erected to him near that of Michel Angelo.

Galileo was of diminutive size, but strong and healthy. His countenance was agreeable; his conversation lively. He loved music, drawing, and poetry. He knew Ariosto by heart; and in one of his works, first printed in 1793 (Considerazioni al Tasso), the product of his leisure hours, he points out the superiority of Ariosto to Tasso, whom he criticizes very severely. He had few books. 'The best book,' he says, 'is nature.' His style is lively, natural, and fluent. A complete edition of his works appeared at Padua (four vols. 4to, 1744), again at Milan (thirteen vols. 1808), and at Florence (in sixteen vols. 1842–56). His true character may be learned from Nelli's Vita e Commercio Litterario di Galilei (two vols. Florence, 1821), and from Sir David Brewster's life of Galileo, in his Martyrs of Science (London, 1841). The most important publications bearing on the matters of controversy mentioned in this article are Les pièces du procès de Galilée, by Henri de l'Epinois (Rome and Paris, 1877); La question de Galilée, by the same (1878); Galileo Galilei und die Römische Kurie, by Karl von Gebler (Stuttgart, 1876; in English, Galileo and the Roman Curia, Lond. 1879); Die Akten des Galilei 'schen Processes, by the same (Stuttgart, 1877); Wegg-Prosser, Galileo and his Judges (Lond. 1889).

GALINGALE, a name applied to the *Cyperus longus*, or to its tubers. See CYPERUS.

GALIPOT, or FRENCH TURPENTINE, according to one account, is a mixture of the resins of the Scotch fir and Bordeaux pine. According to another it is the long, soft stalactitic pieces which form down the sides of the trees by evaporation of part of the volatile oil. When these harden, and require to be knocked off with a hammer or chisel, they are called *barral;* while the mixed lumps of turpentine and galipot at the foot of the trees are known as *crottas.*

GALL, in the animal economy. See BILE.

GALL. See GALLS.

GALL, FRANZ JOSEPH, the founder of modern phrenology, was born in 1758, in Tiefenbrunn, in Baden. He studied medicine, and practised at Vienna as a physician, where he made himself known to advantage by his Philosophisch-medicinische Untersuchungen (two parts, Vienna, 1791). Gall had already remarked at school that some boys who excelled him, in spite of his efforts, in committing things to memory, were distinguished by large eyes. He remarked the same peculiarity afterwards in great actors. Thence he inferred that the talent (the organ) of memory must reside in this part of the head. He afterwards began to collect skulls, carefully comparing the prominences common to all, and those which distinguish them from each other. He compared also the skulls of beasts, studied the habits of beasts and men, the formation of their bodies and brain, and thus came by degrees to assign the particular locations of twenty organs. (See PHRENOLOGY.) Gall did not at first commit his doctrines to writing, but expounded them in lectures, at first in Vienna, where, however, he was for a time prohibited from delivering them, and

in the end received only conditional permission to do so, and afterwards in his travels through the great cities and universities of Germany. He then accompanied his friend Dr. Spurzheim, in 1807, to Paris, where he delivered lectures with more or less success, and continued to reside there as a practising physician. His principal merit is the impulse he gave to the accurate study of the anatomy of the brain. With Spurzheim Gall published at Paris, in 1810, in quarto, Anatomie et Physiologie du Système Nerveux en général, et du Cerveau en particulier. Against the many objections that were made to his views, particularly by Parisian physiologists, he defended himself in his work Des Dispositions innées de l'Ame et de l'Esprit, ou du Matérialisme, &c. (Paris, 1812). Spurzheim also published, in London, a work upon his own and Gall's discoveries, which met with severe criticism. Dr. Gall died in the year 1828.

GALL, St. (German, *St. Gallen*), a canton in Switzerland, bounded on the N. by the canton of Thurgau and the Lake of Constance; E. by the Rhine, separating it from the Tyrol, the principality of Liechtenstein, and part of Grisons; S. by Grisons and Glarus; S.W. by Schwyz; and W. by Zürich. It includes the canton of Appenzell. Its area is 780 square miles. In the south it is one of the loftiest Alpine districts of Switzerland, and in other quarters is more or less mountainous. It belongs wholly to the basin of the Rhine, which, in addition to direct drainage, receives that of the Thur and the Seez. Its principal lake is the Wallenstädersee, the greater part of which lies within its limits; a small part of it is also occupied by the Lake of Zürich. In the valley of the Rhine the climate is comparatively mild, and particularly around Sargans is almost Italian; in the mountainous districts it is very rigorous. The principal productions are, among the mountains, wood and good pasture; on the lower slopes, vines and orchard fruits; where the land is arable, corn, maize, hemp, and flax. The manufactures are chiefly cotton and linen goods, particularly fine muslins, which are extensively made in several districts. This canton was the fourteenth admitted into the Confederation. The constitution is democratical. Every citizen of twenty-one years, not under legal incapacity, has a vote for the members of the Great Council, consisting of representatives of the communes, one representative being returned by each commune under 1200 inhabitants, and an additional one for every 1200 inhabitants above the first 1200. The Great Council appoints the members of the executive, who form the Lesser Council. For administrative purposes the canton is divided into fifteen districts, of which St. Gall is the capital. German is the language spoken. Pop. in 1898, 250,283.

GALL, St., the capital of the above canton and the see of a bishop, occupies part of an elevated valley on the left bank of the Steinach, 19 miles south-east of Constance. The ditches which once inclosed it have been filled up and converted into gardens; but its antique walls, flanked with towers, still remain. The streets are narrow, but the houses are generally substantially built. The principal buildings are the cathedral, of ancient date, but completely modernized, three other churches, an old monastery partly converted into public offices, a large town-house, house of correction, library, and orphan hospital. The manufactures consist chiefly of woollen, linen, and cotton goods, more especially fine muslins and prints; and the trade is very important, St. Gall being the great entrepôt both for its own canton and those of Appenzell and Thurgau. The town is of ancient origin, having grown up around the monastery of St. Gall, founded by a monk of the same name (by birth an Irishman) about the beginning of the seventh century, and rebuilt on a more magnificent plan, under the auspices of Pépin d'Héristal, within 100 years after. The monastery was suppressed in 1805, but the fine church belonging to the abbey still exists; and the other buildings serve as a residence for the cantonal authorities. The inhabitants of St. Gall, at first subject to the abbots of the neighbouring monastery, who were princes of the empire, finally ransomed themselves, and obtained some privileges from the emperors. They were nevertheless compelled to maintain a struggle with the monks for a long period subsequent to the date of their nominal enfranchisement, and it was not till near the end of the seventeenth century that they were able to secure their complete independence. Pop. in 1899, 35,571.

GALLAND, Antoine, an able oriental scholar, was born of humble parentage at Rollot, in Picardy, in 1646. Colbert employed him to travel on the account of government, and his zeal and industry are evinced by several treatises published by him on his return, illustrative of the manners and customs of the Mohammedan empire and religion. He was well versed in antiquarian research, and published a learned treatise on medals and coins; but the work by which he is principally known is his translation of the Arabian Nights' Entertainments. Among his other writings are Tableau de l'Empire Ottoman; De l'Origine du Café; Paroles remarquables, Bons Mots et Maximes des Orientaux; Contes et Fables Indiennes de Bidpaï et de Lokman. M. Galland was received as a member of the Academy of Inscriptions in 1701, and was appointed professor of Arabic at the Collége Royal at Paris in 1709. His death took place at Paris on the 17th of February, 1715. Schefer has edited his Journal written during his stay at Constantinople (2 vols., Paris, 1880).

GALLANTRY. In the times when almost all individuals not of the labouring classes were either clergymen or warriors, and when chivalry fostered alike valour and devotion to the female sex, it was natural that the same word, *gallant*, should have received the double meaning of brave, and attentive to the ladies. Besides, the bravest in battle is generally the mildest towards the defenceless. But when the respect for ladies, which chivalry cultivated, degenerated more and more into frivolous attentions, the word *gallantry*, though always retaining the meaning of *bravery*, also acquired a bad sense.

GALLAS, a numerous and powerful race, chiefly inhabiting a territory in East Africa, lying to the south of the Shoa territory, but dispersed in great numbers over the countries adjoining, especially north and east. They are divided into many tribes, but are all distinguished by the same general characteristics, moral and physical. Their colour varies from a deep black to a brownish yellow; stature tall; bodies spare, wiry, and muscular; frontal profile vaulted; nose often straight, or even arched; lips moderate; hair often hanging over the neck in long twisted plaits. They have agreeable countenances, and are brave, but ferocious and cruel, massacring in war alike the resisting and unresisting, young and old, male and female, ripping up the latter who are pregnant. With their ferocity they unite subtlety and want of faith. Their professions of to-day, if it suits their purpose, are set aside to-morrow, and offered to be renewed without any apparent sense of shame. The Gallas leave the plains to their horses, sheep, and cows; while they themselves seek their maintenance by cultivating the mountains. In doing so they are able to bring up a better cavalry than perhaps any other savage nation. Their arms are a corselet and crooked sabre, a lance, &c., in the forms resembling the representations of those which are found in the ancient monuments of

Egypt and Nubia. Their language is spoken over a considerable area extending south to the equator. The government of each tribe has somewhat of a republican character. The northern Gallas are partly Mohammedans, partly Christians (of the Abyssinian faith); the southern Gallas are heathens. They know only about a Being, whom they call Waka, and to whom, on particular occasions, they sacrifice a cow or sheep. They adorn their graves with taste, but it would appear that this is not the result of good feeling, but of superstition.

GALL-BLADDER, called *vesicula* or *cystis fellica*, is placed on the concave side of the liver, so that one end projects at the anterior margin, while the other points backwards and upwards. It is pear-shaped and about 3 or 4 inches long, and holds from a fluid ounce to an ounce and a half. It consists, 1, of a framework of areolar tissue, the filaments of which are chiefly longitudinal, and mingled in man with plain muscular fibres; 2, of vessels which ramify in the areolar coat; and, 3, of the mucous coat, whose corrugated surface gives hexagonal patterns in the main cavity, while it forms, towards the orifice of outflow, valvular ridges. The bile flows from the liver down the hepatic duct, and, if required in the intestine, passes on down the common canal (*ductus communis choledochus*); but if not needed, or in too great quantity, it flows back along the *cystic duct* into the gall-bladder, which is thus a kind of back-water to the biliary flow. The gall-bladder is covered on greater part of its surface by the peritoneum, which slings it to the liver. The mucous surface furnishes, especially towards the orifice of the cyst, the mucus whose function seems to be to protect the surface from being acted on during long contact with the biliary secretion. Gall-stones consist of material precipitated from the bile (chiefly bile pigment), and forming a nucleus round which gradually layer after layer is deposited of lime salts, bile pigment, and a substance formed in bile called cholesterin. A layer of deposit once formed may become broken up and the fragments form centres of new concretions. Their formation is encouraged by want of exercise and indulgence in too rich diet. See BILE, CALCULUS.

GALLE. See POINT DE GALLE.

GALLEON, formerly a kind of vessels of war, used by the Spaniards and Portuguese, with from three to four decks. In more recent times those vessels were called *galleons* in which the Spaniards transported treasure from their American colonies.

GALLERY, in architecture, a long, narrow room, the width of which is at least three times less than its length, by which proportion it is distinguished from a saloon. Galleries are not destined to be occupied as sitting rooms, but for dancing, music, dining on festival occasions; and are generally decorated with pictures in oil or fresco. Galleries have sometimes been built merely to receive collections of pictures, or to give a painter an opportunity for fresco paintings. Hence a large collection of pictures, even if contained in several adjoining rooms, is called a *gallery*. In ancient times there was a celebrated gallery which is described by Cicero, established by Verres, the well known spoiler of Sicily. It contained, among other beautiful works of art, a statue of Jupiter Ourios (the dispenser of favourable winds); the Diana Segestes, a grand and beautiful statue of bronze, veiled, bearing a quiver on her shoulder, holding a bow in her right hand, and a lighted torch in her left; Apollo and Hercules, the works of Myron; a Cupid by the hand of Praxiteles; a Sappho in bronze by Silanion; and the famous flute-player Aspendus. It also contained a splendid collection of vases, paterse, &c., of gold and silver, decorated with costly gems and engraved stones. The pictures were of equal value and rarity, the tapestries embellished with rich borders of gold, and every part of the gallery enriched with all the splendour that art and wealth could bestow. In modern Europe the gallery founded by Cosmo II. in Florence long held the first place; but it has now been eclipsed by several European galleries. The art treasures of Florence now form two collections, that of the Uffizi, and that of the Pitti Palace. The *galérie du Louvre*, at Paris, is among the finest in the world, though in 1815 it was stripped of many works of art, reclaimed by the different nations from whom they had been plundered. Among the other renowned European galleries are that of Versailles, that of Dresden, the Royal Gallery at Madrid, the Belvedere Gallery at Vienna, the Hermitage at St. Petersburg, the gallery of Berlin, the National Gallery in London, the National Museum at Naples, the Vatican and Borghese collections at Rome, those at Munich, Brussels, Venice, Antwerp, Milan, &c.

The term gallery is also sometimes applied to what is more properly termed a corridor (which see), likewise to a platform projecting from the walls of a building supported by piers, pillars, brackets, or consoles, and in churches, theatres, and similar buildings, to the upper floors going round the building next the wall. In ship-building, a gallery is a balcony projecting from the stern or quarter of a ship of war, or of a large merchantman. In fortification, the name is given to a covered walk across the ditch of a town; and, in mining, to a narrow passage from one part of the mine to another.

GALLEY, a kind of low, flat-built vessel furnished with one deck, and navigated with sails and oars, particularly in the Mediterranean. The largest sort of these vessels, called *galleasses*, were formerly employed by the Venetians. Both galleys and galleasses are mentioned by Shakspeare, in the Taming of the Shrew, where he makes Tranio say:—

> 'My father hath no less
> Than three great argosies; besides two galleasses,
> And twelve light galleys.'

They were about 160 feet long above, and 130 feet by the keel, 30 feet wide, and 20 feet length of stern-post. They were furnished with three masts, and 30 banks of oars, each bank containing two oars, and every oar being managed by six or seven slaves, who were usually chained to it. In the fore part, after the invention of cannon, they had three small batteries of cannon, viz. two 36-pounders, two 24-pounders, and two 2-pounders. They had also three 18-pounders on each quarter, and carried from 1000 to 1200 men. The galleys next in size to these, called half-galleys, were from 120 to 130 feet long, 18 feet broad, and 9 or 10 feet deep. They had two masts, which could be struck at pleasure, and were furnished with two large lateen sails, and five pieces of cannon. They had commonly twenty-five banks of oars, as described above. A size still less than these, called *quarter-galleys*, carried from twelve to sixteen banks of oars. They generally kept close under the shore, but sometimes ventured out to sea to perform a summer cruise. In France were forty galleys for service in the Mediterranean, the arsenal for which was at Marseilles. These galleys in France resembled the hulks of Britain, in which convicts were formerly confined.

The term galley is also applied to the ships of the ancient Greeks and Romans, especially to their war ships, which were propelled chiefly by oars. These were distinguished, according to the number of banks of oars they possessed, into *monēres*, *biremes* (Gr. *diērēs*), *triremes* (Gr. *triērēs*), *quadriremes* (Gr. *tetrērēs*), *quinqueremes* (Gr. *pentērēs*), &c. Those with only one bank of oars were the first in use, and were divided by the Greeks into *pentekontoroi*, *triakontoroi*,

&c., according to the number of oars used; *pentekontoroi* being those in which fifty oars were used (twenty-five on each side); *triakontoroi*, in which thirty oars were used; and so on.

The Greek or Græco-Etruscan vases show many illustrations of biremes, that is, galleys with two banks or longitudinal rows of oars. The invention of this form of vessel was a very important step in advance in naval construction, for it permitted of a large increase in rowing-power in proportion to the bulk and weight of the vessel. With the old one-bank ships extra power was obtainable only at the expense of an increase in the length of the ship, and that increase rendered the additional rowing power almost or entirely useless as a means of obtaining greater speed. The penteconter was normally manned by fifty rowers, twenty-five on each side, whilst in the scarcely larger bireme the number of rowers was nearly one hundred. The great advantage gained by arranging the rowers in more than one bank soon led to the almost complete supersession of the one-banked galley by two-banked, three-banked, four banked, and five-banked ships, and even some of higher rates. It was the trireme, however, which formed the chief war-ship of Greece during her prime. It had three banks of oars on each side, the men in the highest being known as *thranites*, those in the one next below as *zygites*, and those in the lowest as *thalamites*. The numbers of the men in the rows were respectively 62, 58, and 54, equally divided between the two sides (31, 29, 27), the differences in number being due to the fact that the available length was less below than above. The rowers belonging to each set of three, consisting of a thranite, a zygite, and a thalamite, were not placed the one perpendicularly above the other, but the first sat nearest the stern and the last nearest the prow, the three being thus arranged in an oblique line from below upwards. The distance between two neighbouring rowers in the same bank was 3 feet, and from one row to the next above it was a height of 2 feet. The thalamites had the shortest oars, the zygites the next in length, and the thranites the longest, their oars having to strike the water outside of the other two sets. Sometimes an extra bank of rowers was placed on a sort of projecting gangway, which served as a protection to the thranites in *cataphract* or fenced galleys. The port-holes for the oars of the thalamites were probably about 1½ or 2 feet above the water. The seats for the rowers, which were removable, were placed between the sides of the vessel and a series of upright and inclined timbers supporting the main deck. The lowest deck or floor was probably a foot above the water in cataphract triremes, the space below being the hold; and through openings in this deck the baling-buckets were lowered. The keel had under it a strong false keel to facilitate the beaching of the vessel; above it was the kelson, over which was another false keel into which the masts were stepped when in use. The stem of the vessel was generally curved, and terminated in an ornamental *acrostolium* or figure-head, and the stern-post was also usually curved upwards and finished off ornamentally. Assisting to support the deck were cross-beams laid over the ends of the ribs, which curved upwards and inwards from below. On either side of the deck there usually rose a lattice-work acting as a screen, which was often covered with hides or goat's-hair curtains. At the stern there was an elevated quarter-deck, whence the helmsman and the trierarch or naval captain gave their orders. The latter had full command of the ship; the former acted as navigating officer, having the oarsmen and sailors under his command. Originally the helmsman personally worked the steering-gear, which consisted of two large oars or paddles, one on either side of the vessel. The trireme had regularly two masts—a main-mast with one large sail, and a very small fore-mast.

The rowers formed much the largest portion of the crew, while an Attic trireme carried also ten marines (*epibatæ*), seventeen sailors, a sort of pay-master, two men in charge of the lines of rowers, besides a *keleustês* and a *trieraulês* (the latter with a flute) to give the time to the rowers. The total crew would thus be about 220. The total length of a trireme was about 120 feet, of which about 100 was devoted to the rowers; the breadth at the water-line was some 12 feet; and the draught about 6 feet. A speed of 8 or 9 knots was probably about the highest obtainable. The triremes were provided with beaks used for the purpose of ramming. The desire for larger vessels ultimately led to the introduction of quadriremes, quinqueremes, hexeremes, octeremes, &c., culminating in Ptolemy's gigantic tesseraconteres, with forty banks of oars—a vessel no doubt built more for show than for actual use.

The Romans did not become important as a maritime nation till the period of their struggle with Carthage. At that time they were compelled to resort to the sea, where their extraordinary energy and the extremely practical character of their genius soon gave them supremacy. They built large numbers of ships, chiefly of higher rates than the trireme, and introduced various appliances on board suitable for close fighting. But the triumph of the bireme vessels, known as Liburnian galleys, at Actium led the way for a reversion to lower-rated ships. (See article NAVIS, in Smith's Dictionary of Greek and Roman Antiquities, 3rd ed.)

Galley was also a name given to an open boat formerly used on the river Thames by custom-house and other officials, and also for pleasure.

Galley or *gally*, is also the name given to the place where the victuals are cooked in a vessel, often also called the *caboose*.

GALLEY-SLAVE, a person condemned to work at the oar on board a galley, being chained to his post. This mode of punishment was at one time common in France, but it was replaced about the middle of the eighteenth century by forced labour. Although it is first mentioned in a decree of Parliament of 1532, yet it is believed to be as old as the fourteenth century. It was first used only against gipsies, vagabonds, false-coiners, &c., afterwards against all malefactors, except women, invalids, maimed and aged persons.

GALL-FLY. Several hymenopterous insects of the family *Cynipidæ* form the morbid products known as *galls*. These productions are found on various kinds of plants, and on different parts of a plant, each species seeming to be addicted to a particular plant and organ. Thus, the leaves, the peduncles of the leaves, the stems, or the roots may be each the special localities. The ovipositor, spirally coiled within the abdomen of the female gall-fly, is, when required, suddenly straightened, and in the puncture thus made in the plant one or several eggs are deposited. The hatching of the larva sets up an irritation which produces the gall. The *Cynips quercus baccarum* is of a black colour, with black antennæ and black-and-yellow legs. It produces galls about the size of a red currant on the leaf or catkin. *C. folii* is a shining black insect to whose action the common cherry-sized galls on the under side of the leaves are due. The small galls found on the same part of the oak are produced by about half a dozen species. The galls on the stems of oaks are due to *C. terminalis*, in which the males and

females differ in colour and ornament. Several larvæ are in each gall, and more than one generation is hatched during a season. The shrubby oak (*Quercus infectoria*) of Syria is attacked by *C. gallæ tinctoriæ*, which gives rise to a hard unicellular gall, that chiefly used in commerce. The hairy gall of the rose, called a *bedeguar*, is the work of a species of *Rhodites* with glossy black body and clouded wings. The larvæ in this, as in the oak gall, usually come out the following spring. Those insects which are hatched in the receptacle of the fig break out when the anthers are shedding their pollen, and thus take some share in fertilization, since they carry pollen from one plant to another. The galls of the willow are the work of a saw-fly, which slits the leaf parallel to its surfaces. The tissue of these galls differs less from that of the leaf than does the gall of the *Cynipidæ*. See GALLS.

GALLIA. See GAUL.

GALLIC ACID ($C_7H_6O_5$). This acid derives its name from the gall-nut, whence it was first procured by Scheele in 1786. It has been found besides in many other plants, in acorns, colchicum, dividivi, hellebore root, sumach, tea, walnuts, &c. &c. It may be obtained by the following process:—Digest bruised galls in boiling water, with vellum cuttings or other gelatinous matter, for some hours, then allow the mixture to cool, and filter it. Add to the filtered liquor a solution of acetate of lead as long as it contains any precipitate, pour the whole upon a filter, wash the precipitate with warm water, remove the lead by dilute sulphuric acid or by sulphuretted hydrogen, filter, concentrate, and recrystallize the gallic acid which deposits. The use of lead may be dispensed with if the filtrate from the gelatine precipitate be evaporated to dryness, exhausted with alcohol, this solution evaporated, extracted with water, and crystallized. The best process is that originally employed by Scheele. The bruised gall-nuts are moistened and exposed for four or five weeks to a temperature of about 80°. A mouldy paste is formed, which is to be squeezed dry, and digested in boiling water. It then affords a solution of gallic acid, which is decolorized by animal charcoal, and which, on evaporation, yields the acid in white needles. Other methods have been proposed for extracting it from plants; and it can also be prepared artificially by the decomposition of other organic compounds.

Gallic acid, when pure, is in whitish silky triclinic crystals, of a sour taste, which exhale a peculiar smell when heated. It dissolves in about twenty-four parts of water at 60°, and in three parts at 212°. It is also soluble in alcohol and in ether. When sublimed about 410° Fahr. it decomposes into carbonic acid gas and pyrogallic acid. When kept heated at about 450° it gives a soluble brown substance called *gallulinic* acid; but if heated up to 480° it gives an insoluble black body called *metagallic* acid. By the action of the air and of alkalies and alkaline earths, gallic acid gives various decomposition products. The compounds of gallic acid with metals are rather difficult to prepare, and are not specially of interest. The gallates of all the common metals have been analyzed, however, and they can be got in crystals or crystalline crusts of definite composition. The alkaline gallates are in white needles, readily soluble in water; they require particular care in their preparation, as they are apt to absorb oxygen, and become brown. Most of the others are insoluble or sparingly soluble in water. With iron, gallic acid gives a deep blue colour, which is destroyed by heat. This must not be confounded with the inky precipitate produced by tannin or an infusion of nut-galls as a whole. See TANNIN and INK.

GALLICAN CHURCH, a distinctive name applied to the Roman Catholic Church in France. The peculiarity of this church consists not in any diversity of doctrine or practice from those generally held and observed by Roman Catholics in other countries, but in maintaining a greater degree of independence of the Papal see, more especially by denying the validity of many of the decretals issued since the time of Charlemagne, and refusing to allow the pope to interfere with the civil jurisdiction of the state and the sovereign rights of the crown. The freedom asserted in this respect was to a certain extent legally recognized in 1269 by the pragmatic sanction of Louis IX. (the authenticity of which has, however, been questioned), but was extended and more completely effected in 1438 by the pragmatic sanction which was concluded between the pope and Charles VII. This second pragmatic sanction was annulled in 1516 by a concordat concluded between Leo X. and Francis I.; but a more ample definition and extension of the privileges of the Gallican Church was effected in 1682 by the Quatuor Propositiones Cleri Gallicani. It was occasioned by a quarrel between Louis XIV. and Pope Innocent XI. as to a right, named *La Régale*, which the kings of France had till then maintained, and in virtue of which they had been accustomed, during the vacancy of a see, to possess the inferior ecclesiastical benefices as their own. In consequence of this quarrel the king, in 1681, assembled in Paris a convocation of the French clergy, who adopted a declaration drawn up by the celebrated Bossuet, and containing the four following articles:—1. The pope in secular matters has no power over princes and kings, and cannot loose their subjects from allegiance to them. 2. He is subject to the decrees of a general council. 3. His authority in France is regulated by fixed canons and the laws and customs of the kingdom and church. 4. In matters of faith his decision is not unalterable (*irreformable*). The declaration, after being accepted by the assembly, was confirmed by royal decree, March 23, 1682. Although the articles were not regularly enforced they remained, as parts of the civil and ecclesiastical law, powerful weapons for opposing the encroachments of the Roman court. The revolution entirely overthrew the ecclesiastical establishment of France; the priests were deprived of their lands and revenues, the schools and seminaries for the education of ecclesiastics were suppressed, and the church itself abolished. Bonaparte, as first consul, concluded a concordat with Pope Pius VII. in 1801 re-establishing the ecclesiastical authorities, and institutions for the education of ecclesiastics were again erected, but as emperor he soon quarrelled with the pope respecting the new organization of the church, made him prisoner, and tried to effect by force what he had not been able previously to obtain. Pius VII., however, steadily refused to give canonical induction to the bishops nominated by the emperor, and Bonaparte saw himself compelled in 1809 to convoke an assembly of the French clergy for consultation. As they declared the induction of bishops by the pope to be indispensable, new negotiations were commenced, and the pope, under the pressure of circumstances, in 1811 inducted the emperor's bishops, and in 1813 concluded a concordat with Napoleon at Fontainebleau. This concordat, however, as soon as he returned to Rome, he declared null, on the ground that it had been extorted from him by compulsion. On the return of the Bourbons the deprived bishops were restored, and Louis XVIII., in 1817, concluded a new concordat, which in many respects was very unpopular. To counteract this unpopularity the government caused all superiors and professors of episcopal seminaries, and all bishops, solemnly to declare that they adhered to the articles of 1682. The July revolution in 1830 gave full free-

dom to all denominations, and a clause to this effect was inserted in the Constitutional Charter. Latterly the position of the Gallican church towards Rome has essentially changed, and the older Gallicanism is now best represented by the Old Catholics of France.

GALLIENUS, P. LICINIUS VALERIANUS, a Roman emperor, received the title of Cæsar from the senate at the same time with his father, Valerianus, and associated with the latter in the empire on his accession in A.D. 253. His father having been defeated and taken prisoner by Sapor, king of the Persians, in 260, Gallienus showed complete indifference, and continued to reign alone without making any attempt to deliver his father. With a like indifference he saw his empire dismembered by numerous usurpers (the 'Thirty Tyrants'), and invaded in all parts by barbarians. Yet he was not destitute of personal courage or military skill, and when he was at last roused from his effeminate addiction to pleasure, he defeated the Goths in Thrace, Postumus in Gaul, and Aureolus, whom the legions of Illyria had proclaimed emperor, in Italy. The last he forced to take refuge in Milan, and he was making preparations to reduce him there, when he himself was assassinated by one of his officers, A.D. 268.

GALLINÆ, gallinaceous birds; the Linnean term for the group of birds now commonly known by Illiger's name *Rasores*. Under this group come domestic fowls, pheasants, turkey, grouse, Megapodius, &c. The domestic fowl, or rather its probable progenitor the Jungle Cock, *Gallus bankiva*, was the type of this order; but that genus is now referred to the family of pheasants (*Phasianidæ*).

GALLINULE: two genera of aquatic birds, *Gallinula* and *Porphyrio*, belonging to the family *Rallidæ* or rails, are known by this name. They are good swimmers, though they are not web-footed, but have the toes furnished with a narrow membrane. The common gallinule, or water-hen (*G. chloropus*), is common in Britain. Upper plumage, deep olive brown; under, blackish gray. The purple gallinule (*Porphyrio hyacinthus*) is also British. These two genera are included in a sub-family along with the New Zealand *Notornis* and the coot (*Fulica*).

GALLIOT, a Dutch or Flemish vessel for cargoes, with very rounded ribs and flattish bottom, with a mizzenmast placed near the stern, carrying a square mainsail and maintopsail, a forestay to the mainmast (there being no foremast), with forestay-sail and jibs.

GALLIPOLI (ancient *Callipolis*), a seaport in Italy, in the province of Lecce, on a rocky peninsula in the Gulf of Taranto, and 47 miles south-east of the town of Taranto. It is fortified and well-built, and has a cathedral, several churches, convents, and public schools, manufactures of woollen goods, muslin, and hosiery, a productive tunny fishery, and a good harbour, from which large quantities of olive-oil and cotton are exported. Pop. 9000.

GALLIPOLI (ancient *Callipolis*), a town in European Turkey, on a peninsula at the north-east end of the Dardanelles, 128 miles W.S.W. of Constantinople. It was once fortified, and still retains some of its defences in a very dilapidated state, is poorly built, consisting of narrow dirty streets, with no edifice of any note except the bazaars; and has manufactures of cotton, silk, and morocco leather, and two harbours, one used as a station for the Turkish fleet, and the other for trade, consisting chiefly in corn, wine, and oil. It is the seat of a Greek bishopric. It was here that Frederick Barbarossa in the third century led his troops across the Dardanelles, and it was also the gate by which the Turks entered Europe, having been taken by Bajazet not long after the middle of the fourteenth century. In the Crimean war against Russia the allied forces of the English and French landed here in 1854. Pop. about 30,000.

GALLIPOLI OIL. This constitutes the largest part of the coarse olive-oil imported to this country which is used in Turkey-red dyeing and for other purposes in the arts. It is prepared from olives grown in Calabria and Apulia—the latter being considered the best—by a very rude process. The ripe olives dropped by the trees are collected and squeezed in a mill. The oil is conveyed in skins on muleback to Gallipoli, where it is clarified by subsidence, conveyed to the sea-shore, and transferred from basins or reservoirs, in which it is kept there, to the casks in which it is shipped.

GALLITZIN, or GLYZIN, the name of a princely family, one of the most distinguished in Russia, which has furnished numerous statesmen and soldiers, both in ancient and modern times. Among the latter is Alexander Nicolaievich, who was minister of public instruction and worship from 1817 to 1824. His name became well known in Great Britain, and was the theme of much and not undeserved eulogy, in consequence of the interest which he took in promoting the circulation of the Scriptures. Having become president of the Russian Bible Society in 1812, he gave his hearty support to this good cause, and was well seconded by the Emperor Alexander, who was too liberal-minded to think that anything but good could result from giving his subjects the Bible in their vernacular tongue. The Emperor Nicholas took a different view, and in 1826 issued his fiat by which the Russian Bible Society was suppressed. Gallitzin died in the Crimea in 1844.

GALLIUM, a new metal discovered in 1875 by M. Lecoq de Boisbaudran by means of spectrum analysis in certain blendes of France. It has as yet been prepared in only exceedingly minute quantities; in its properties it is related to aluminium.

GALL-NUTS. See GALLS.

GALLON, an English measure of capacity, being equal to 4 quarts, or 8 pints. Before the passing of the act establishing uniformity of weights and measures in the United Kingdom, three different standards of capacity were in use. These were the old corn-gallon of 268·8 cubic inches, the old wine-gallon of 231 cubic inches, and the old beer-gallon of 282 cubic inches. By act 5 George IV. cap. lxxiv. (June 17, 1824) all these old measures were abolished, and a uniform standard settled for liquid-measure as well as for dry-measure in the case of all articles not measured by heaped-measure. This standard was the imperial gallon, which contains 10 lbs. avoirdupois of distilled water weighed in air at the temperature of 62° of Fahrenheit's thermometer, the barometer standing at 30 inches. The imperial gallon thus contains 277·27384 cubic inches, or about 4½ French litres.

GALLOON, in commerce, a narrow kind of lace used to edge or border cloths.

GALLOTANNIC ACID. See TANNIN.

GALLS are morbid growths, excessive deposits of vegetable matter around wounds inflicted by certain insects, belonging to the hymenopterous family *Cynipidæ*, and, in the case of the willow, to the family *Tenthredinidæ:* but these last do not give rise to objects of commercial value. These tumours are of three kinds, those consisting of one piece, those of several pieces, and those whose surface is covered with a silky matted down. The galls are nut-like, and might easily be mistaken for fruit. Their texture varies, being either solid or spongy, containing one or several cavities, in each of which a larva is lodged. Though galls are very generally distributed, they occur in commerce chiefly as Levantine articles of trade, those of Persia thus reaching the European market. The Aleppo nut-

galls are spherical and tubercular: blue, black, and white varieties are recognized, the two former being picked before the escape of the larva, the latter after its exit. The largest British forms are the *oak galls* due to the attack of *Cynips quercus terminalis*; the smallest are the *currant galls*, the insect of which is *C. q. pedunculi*. The Dead Sea Apples, or Mecca or Bussorah galls, or Apples of Sodom (*mala insana*, or *C. q. infectoriæ insana*), are varieties of this vegetable product. The *artichoke* or *strobile galls* consist of several pieces, and resemble the fruit (*strobilus*) of the hop; it is due to the abnormal development of the female involucre before fecundation: its insect is the *C. q. gemmæ*. The hairy galls, or bedeguars, or rose sponges, are chiefly found on *Rosa rubiginosa*; they are produced by a number of the family Cynipidæ known as *Rhodites rosæ*. The astringent properties of galls, which render them important articles in the arts and manufactures, are due to the presence of gallic and tannic acids (which see). A Chinese production known as China wax is also the product of a gall insect, but in this case the gall is formed on a different tree from that on which the wax is formed. See CHINA WAX.

Galls, as regards composition, consist of about 11 per cent of cellulose, 1·2 of starch, 70 to 80 of tannic acid, and the rest of gallic, ellagic, and luteogallic acids, colouring and extractive matters, gum, and inorganic salts. The principal value of the gall-nuts turns upon the tannic acid present, and those which are richest in this ingredient are the Aleppo galls. Inferior kinds are sometimes used; they can be distinguished from the others by their size, colour, and external appearance. Gall-nuts are largely employed for making ink by precipitation with iron, for dyeing and printing, and for tanning; for all these purposes it is the tannic acid that is of value. In 1899 there were imported into the United Kingdom 26,163 cwts. of galls, value £68,498.

GALL-STONES. See CALCULUS—Biliary Calculi.

GALLY, in printing, a frame into which the compositor empties the lines out of his composing-stick, and in which he ties up the page when it is completed. Some gallies are formed of an oblong board with a ledge on three sides, and a groove to admit a false bottom, called a *gally-slice*.

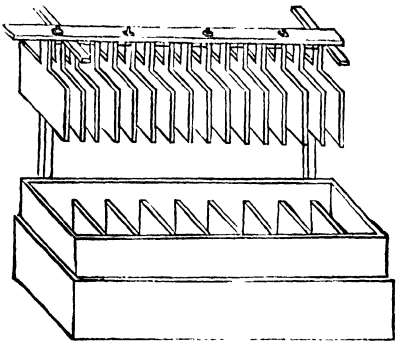
GALT, JOHN, a distinguished author and novelist, was born in the town of Irvine, in Ayrshire, on 2d May, 1779. Before he left school his parents removed to Greenock, and here he was placed first in the custom-house, and afterwards in a merchant's office. He wrote at an early age a tragedy on Mary Queen of Scots, for which he was unable to find a publisher. He next attempted an epic, entitled The Battle of Largs, parts of which appeared in the Scots Magazine of 1803 and 1804. In the last-mentioned year he went to London, and entered into a mercantile partnership with a countryman of his own, but the venture soon ended in bankruptcy. He then resolved to try the legal profession, and entered himself at Lincoln's Inn, but, partly from disrelish and partly from ill health, he made small progress in his studies, and he quitted England in 1809 for the purpose of re-establishing his health. He made a tour extending over three years to various places in the south of Europe and the Levant. On his return in 1812 he published two works connected with his journey, one entitled Voyages and Travels in the Years 1809, 1810, and 1811, containing Statistical, Commercial, and Miscellaneous Observations on Gibraltar, Sardinia, Sicily, Malta, and Turkey; and the other, Letters from the Levant, containing Views of the State of Society, Manners, Opinions, and Commerce in Greece and several of the principal Islands of the Archipelago. The same year appeared his Life of Cardinal Wolsey, which he had commenced before quitting England, and also a volume of tragedies, which received a rough handling from the Quarterly Review. About this time he married the daughter of Dr. Tilloch, editor of the Philosophical Magazine, and became a contributor to the Monthly Magazine and other periodicals of the day. With Mr. Colburn the publisher he projected a periodical, which, under the title of the New British Theatre, should publish the best of those pieces which had been rejected by the managers of the great theatres. The plan was tolerably successful at first, but had ultimately to be abandoned. Among his other literary labours of this period were the tragedy of The Witness, a life of West the Painter, and a romance on the legend of the Wandering Jew. In 1820 and 1821 the Ayrshire Legatees, a series of letters descriptive of a supposed visit by a Scottish minister's family to London, appeared in Blackwood's Magazine, and attracted universal attention. It now became evident that his strength lay in his powers of humorous description, and in the delineation of Scottish life and character of the middle or lower ranks. Its success induced him to publish immediately afterwards his Annals of the Parish, which had been written as far back as 1813 and laid aside, but which was now received with no less approbation. Galt now assiduously followed up the track in which he had found acceptance, and the Provost, the Steamboat, Sir Andrew Wyllie, and the Entail appeared in rapid succession. These were all extremely popular, but his subsequent novels, which, abandoning the field of modern Scottish life, aimed at depicting the manners of a by-gone period, did not sustain the reputation which he had acquired. They include Ringan Gilhaize, a tale of the Covenanters, intended to vindicate their character, which was thought by their admirers to be unfairly represented by Sir Walter Scott in Old Mortality; the Spaewife, a tale of the fifteenth century in Scotland; and Rothelan, a historical romance, the scene of which is laid in England in the reign of Edward III. In 1826 he proceeded to Canada as superintendent to the Canada Company, and was employed in purchasing and colonizing land. For this appointment he did not show much capacity, and was deprived of his office and returned to England in 1829. While in Canada he wrote the tale of the Omen, the novel of the Last of the Lairds, and two farces, both acted with considerable success, one at Quebec, under the title of Visitors, or a trip to Quebec; and the other, entitled An Aunt in Virginia, played at New York, and afterwards published in Blackwood's Magazine. After his return to England he had to make a composition with his creditors. He set himself resolutely to work, however, at his literary tasks, and produced successively Laurie Todd, Southennan, and a Life of Lord Byron. He also undertook the editorship of the Courier, a Tory newspaper, but the occupation proved uncongenial, and he returned to Scotland. His strength had been undermined by two attacks of paralysis, but his literary activity was still unabated, and among other publications he produced the Autobiography of John Galt in two, and the Literary Life and Miscellanies of John Galt in three vols. He died at Greenock on 11th April, 1839. Galt was a most rapid and prolific writer, his writings comprising about fifty volumes of novels, besides more than twenty dramas, and numerous works on biography, travel, and other subjects.

GALVANI, LUIGI, an Italian physiologist, known as the discoverer of animal electricity or galvanism, was born at Bologna, Sept. 9, 1737. At an early age he exhibited a disposition to a monastic life, and his

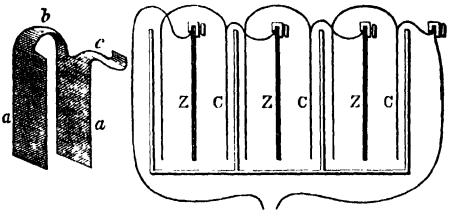
studies were chiefly in connection with theology. Persuaded by his friends to abandon his intention of entering the church, he subsequently studied medicine, and having distinguished himself by a thesis on the nature and formation of the bones, in 1762 he entered on the practice of his profession. His favourite studies were anatomy and physiology. He soon received the appointment of professor of anatomy in the celebrated institute of his native city, and published an interesting treatise on the urinary vessels of birds. Encouraged by the approbation with which this work was received, he resolved on writing a complete physiology of birds, but he afterwards confined himself to an investigation of the organs of hearing. While engaged in these pursuits he was fortuitously led to the discovery which has immortalized his name. His wife, the daughter of Galeazzi, a medical professor under whom he had studied, and a woman of superior intelligence, having observed that the contact of the inanimate body of a skinned frog with a scalpel lying on the table produced in the frog a series of remarkable muscular convulsions, the knife being in contact with an electric machine, informed her husband of the fact, who instituted a series of experiments, and formed conclusions which led to a controversy with Volta, for which see the following article. On a journey to Sinigaglia and Rimini he was so fortunate as to trace the cause of the electric appearances which are observed in the torpedo, and wrote a learned treatise on this subject. Simple in his manners and wishes, and being naturally inclined to melancholy, he avoided general society. The loss of his beloved wife in 1790 rendered him inconsolable. Having refused to take the oaths to the Cis-Alpine Republic, he was deprived of his chair, and refused to resume it, when the government, in consideration of his celebrity, offered to allow him to do so unconditionally. He retired into the country, and died Dec. 4, 1798. In Rome a medal was struck with his effigy.

GALVANIC BATTERY. Under GALVANISM Volta's invention of the pile in 1800 is described. The first battery properly so called was his *couronne de tasses*. In the same year Mr. Cruickshanks of Woolwich devised an improved form of the apparatus, which was simply a horizontal pile. It consisted of a long and narrow trough of baked wood, in the inside of which vertical grooves were cut, at intervals of about ½ inch, and into these grooves sixty zinc and copper plates, previously united together in pairs by soldering, were let down and well secured by cement. The interstices or cells between the different pairs were filled with either dilute sulphuric acid or a solution of chloride of ammonium, or of common salt (chloride of sodium).

In point of compactness Cruickshanks' battery was a very considerable improvement on the voltaic pile, but still it was attended with great practical inconveniences, arising from the difficulty of cleaning or renewing the plates, the necessity of pouring out the liquid to arrest the chemical action, and other causes. A modification suggested by Mr. Babington obviated these disadvantages. In this arrangement—shown in the annexed figure—the plates are movable, so that they can be lifted out of the liquid at pleasure, and instead of being soldered together by their flat surfaces, each of the pairs is united at one point only by a slip of metal passing from the one and soldered to the other. The trough is divided by a series of water-tight partitions, which may be of the same material as the trough, into as many cells or compartments as there are pairs of plates to be used; and the latter, being all connected together by a bar of hard wood, are so arranged that, when let down into the trough, a zinc and a copper plate of each two adjoining pairs pass into the same cell. This form of battery was long used for working the electric telegraph in this country.



In 1815 Dr. Wollaston suggested a further improvement by which both sides of the zinc plates were utilized. This consisted in doubling the copper plates so as to pass *under* and on *each side* of the zinc plates. A better arrangement on the same principle is shown in the next figure; *a b c* is the form given to the plates of copper, and these are doubled *over* instead of *under* the zinc plates, thereby allowing any impurities to fall freely to the bottom of the trough instead of collecting upon the coppers. Each of the latter is connected by a binding-screw and by means of the slip *c* with the zinc plate of the next cell. This is the best form of the simple voltaic combination, and a battery so constructed is equivalent to a Babington or Cruickshanks battery with zinc plates of double the size.



All these different forms, however, are substantially the same in principle, varying only in construction; and supposing the liquid to be, as is generally the case, water acidulated with $\frac{1}{10}$th to $\frac{1}{12}$th of sulphuric acid, the chemical action is as follows: the zinc unites with the oxygen of the water, and hydrogen is liberated at the copper or negative plate; the oxide of zinc formed unites with the sulphuric acid, and forms a sulphate of zinc, which is soluble in the water; a new surface of zinc is thus continually exposed to the oxidizing action of the water, while the presence of the sulphuric or other acid acts also a most important part by increasing the conducting power of the liquid.

A valuable improvement, applicable to all batteries in which zinc and acid are used, was suggested by Mr. Kemp of Edinburgh in 1826. The best commercial zinc is full of impurities, consisting of particles of iron, cadmium, and other metals, by means of which, in presence of acid, secondary currents are set up at the surface of the zinc itself, and consequently a considerable quantity of the zinc is uselessly consumed. This is termed *local action*, and Mr. Kemp found that it was obviated by forming the surfaces of both sides of the zinc into an

amalgam with mercury. This may be effected by rubbing the plates, after being scoured, with a solution of nitrate of mercury in nitric acid; but a better plan is to place the plates for a short time in dilute sulphuric acid, and then to brush them well over with metallic mercury. In making a battery in which sulphuric acid is to be used this process should never be neglected. The amalgamated plates endure much longer than those that have not been amalgamated; and when the circuit is broken they are scarcely attacked in the slightest degree by the acid, whereas with unamalgamated plates the local action is rapid. If salts, however (as a solution of chloride of sodium or of sulphate of zinc), be used for the exciting liquid, the process of amalgamation may be dispensed with.

In 1835 Dr. Faraday found that, with Wollaston's double-copper arrangement, the great care previously taken to insulate the different elements from each other by water-tight partitions was quite unnecessary, provided the plates were of such a size as nearly to occupy the whole width of the trough. In this arrangement the copper surfaces of each two adjoining elements confront each other, and consequently there is no action between them, while the conductivity of the liquid is so low compared with that of the metals that scarcely any of the current passes at the edges of the plates.

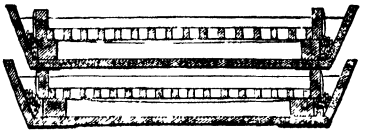
Although the common trough battery thus constructed, with double coppers and amalgamated zincs, appears to admit of no essential improvement, yet it has certain serious defects which seem to be inseparable from all batteries composed of similar elements. In the first place the liquid is soon saturated with the sulphate or other salt of zinc; secondly, the copper becomes covered with an oxide and other impurities, which gradually impair the action; in the third place, a portion of the disengaged hydrogen strongly adheres to the negative plate, so as to form a gaseous film over its surface which obstructs the passage of the current; and fourthly, the adhering hydrogen, by its tendency to recombine with the oxygen, and by polarizing or exciting positively the negative plate, sets up a counter current, which gradually increases in force till it almost overpowers the direct one. The combined result of these several sources of obstruction, and more especially of the last, is a rapid diminution of energy in the common battery, so much so that in a few minutes its power, if the circuit present little resistance, frequently diminishes by one-half. With a battery so inconstant in its action it was almost impossible to study successfully either the laws of electricity or of electro-chemistry. A great advance was therefore made in the science, as well as in the arts, when Professor Daniell in 1836 invented his *constant battery*.

Fig. 1, Pl. II. at ELECTRICITY represents a Daniell's cell. There is first a cylindrical copper vessel, *c c*, about 3 inches in diameter and 6 inches high. Within this is placed another cylindrical vessel, *d d*, made of some porous substance, such as pipe-clay or unglazed porcelain. Within the porous cell a solid cylinder, *z z*, of amalgamated zinc, is suspended by a wooden pin passed through its upper extremity. The outer or copper vessel, *c c*, is filled with a saturated solution of sulphate of copper, commonly called blue vitriol, to which may be added a little sulphuric acid to increase its conducting power; the porous cell, *d d*, is filled with a saturated solution of common salt, or with dilute sulphuric acid, in the proportion of about 1 part acid to 20 parts water. When a connection is made between the opposite poles by means of the wires *g z*, *b c*, a powerful current is generated, which remains remarkably constant as long as the solution of sulphate of copper in the outer vessel is kept constantly saturated. This is effected by placing crystals of the sulphate on a perforated copper shelf, *q q*, fixed in the inside of the copper vessel near the top.

The rationale of the action in this battery is as follows: in the first place the porous cell, while it prevents the two liquids from mixing, permits free electrical communication between them, and therefore between the two metals; inside the porous cell, as in the common battery, the zinc is oxidized by combining with the oxygen of the water, and the oxide of zinc thus formed, combining with the sulphuric acid, is rapidly dissolved off as a sulphate, hydrogen being thus liberated. In the outer vessel the solution of sulphate of copper is decomposed, and thus the hydrogen of the decomposed water, instead of being liberated from the surface of the copper, as in the common battery, combines in its nascent state with the oxygen of the oxide in the sulphate of copper, by which the copper is reduced in the metallic state upon the surface of the cylinder of that metal forming the outer vessel. The copper is therefore retained always bright, being in fact continually renewed by a constant deposition of that metal; no hydrogen adheres to it, so that there is no polarization, and no gas whatever is disengaged. Hence the extreme constancy of this battery, which may be proved by testing with a galvanometer inserted between *b* and *g*. At whatever angle the needle is deflected on completing the circuit, there it will remain for hours with unwavering steadiness.

Instead of using a copper vessel as the outer cell, a small rectangular sheet of copper, bent into a cylindrical shape, may be inserted in a glass tumbler or earthenware jar containing the sulphate of copper. But the relative position of the zinc and copper in the battery is evidently not essential, provided they are separated by the porous vessel, and each is immersed in its proper liquid. In the Daniell's battery employed for working the French telegraphs, the copper plate and sulphate of copper are put into the porous cell, which is surrounded by a cylinder of zinc in a small glass or stoneware vessel containing pure water without any acid. This arrangement is shown in series in fig. 2, Pl. II. at ELECTRICITY. From the rim of each of the zinc cylinders proceeds a slip of copper connected with the copper cylinder, which is inserted in the porous cell of the next element. This arrangement may be improved by substituting for pure water solution of sulphate of zinc; and, indeed, during the working of the battery the pure water rapidly becomes impregnated with that salt. There is no form of battery that has proved of so much practical importance as that of Daniell. Many modifications of it have been employed under various names for telegraphic purposes. The battery commonly known as Menotti's battery has been and is much used. We must, however, refer our readers for particulars with respect to most of the various forms to detailed works on electricity. Here we content ourselves with describing the latest and the most important form of the battery, planned by Lord Kelvin, and used by him in connection with his telegraphic instruments. Two cells of this kind are shown in the accompanying diagram in section. A tray 22 inches square, made of wood and lined with lead, holds the liquid. Four blocks of wood are placed at the four corners, and support the zinc, which is cast with bars like a gridiron instead of being one solid plate. The ends of the gridiron bars are shown in the diagram. The gridiron form is adopted in order to allow the bubbles of hydrogen that always form about the zinc to escape easily. On the bottom of the lead tray a copper plate is laid, and this forms the positive plate of the battery. The liquids used are solutions of sulphate of zinc and

sulphate of copper, the latter of which, being the heavier, remains at the bottom, and is maintained in



strength by crystals placed on the copper plate. The zinc is protected from the copper by having very strong thick paper, known as parchment paper, or Manilla paper, tied round it. This while it allows, when it has been thoroughly wet, perfectly free electrical communication between the two plates, hinders the sulphate of copper in the solution from being carried up to the zinc by currents of the liquid. The cells are placed one on the top of the other, and a strip of lead carried round to the outside of the wooden tray, and resting on the zinc of the cell below, makes the necessary communication between the cells. Eighty such cells are now in use in the laboratory of Glasgow University, and give a splendid electric light, which may be maintained for hours, or days if necessary, at a time, by merely keeping up the supply of sulphate of copper. The cells are also used at all the telegraphic stations where Lord Kelvin's well-known siphon recorder is employed.

A combination more energetic than that of Daniell was discovered by Mr. Grove, in 1839. The general arrangement is similar to that represented in fig. 2, but the porous cell is filled with the strongest nitric acid instead of sulphate of copper, and contains, instead of the copper cylinder, a slip of platinum. This arrangement is shown in fig. 3. D is the porous cell; P the slip of platinum. The exterior vessel V may contain either a solution of common salt, or (if the zinc Z be amalgamated) dilute sulphuric or hydrochloric acid. This combination possesses higher electromotive force than any other in common use, but it is not so constant as Daniell's. Its advantages depend partly on the fact that platinum is the least liable of the metals to oxidation, whilst zinc is one of the most readily attacked by acids; partly on the high conducting power of the nitric acid; but chiefly on the facility with which that acid parts with a portion of its oxygen to combine with the nascent hydrogen, while peroxide of nitrogen is disengaged. The disagreeable fumes of this gas are the principal objection to the use of Grove's battery; but with only a few cells, and a solution of chloride of sodium in the outer vessel, they occasion little inconvenience.

In 1843 M. Bunsen suggested a useful modification of Grove's battery, in which, with a view to economy, cylinders of carbon, prepared by heating together a mixture of powdered coke and caking coal, are substituted for the platinum plates. The residuum taken from the retorts of gas-works is found to be admirably fitted for the purpose; and by soaking the coke in sugar and calcining a second time in a mould, great compactness is given to the mass, which may be used either in the form of cylinders or flat cakes. Its efficiency as a substitute for the platinum arises from the fact that, next to the metals, charcoal is the best known conductor of electricity, while it is not chemically acted on by the nitric acid. Bunsen's battery, depending on precisely the same principles as Grove's, supplies for some considerable time a current not less energetic with plates of equal size; and when very great power is required for special purposes, this can be obtained at little expense by enlarging the size of the charcoal plates or cylinders to any desired extent. Fig. 4 exhibits one form of this battery; C is the carbon cylinder inserted into a porous cell D containing the nitric acid, Z a sheet of zinc bent into a cylindrical form, so as to surround the porous cell, and immersed in dilute acid or a solution of salt, contained in a glass or stoneware jar V. The connecting copper wire or ribbon is often attached to the cylinder of carbon either by means of a brass collar E, or a pin thrust into its axis; a clamping screw for pressing the copper ribbon temporarily against the side of the carbon cylinder is preferable, because the brass collar is soon corroded by the nitrous fumes.

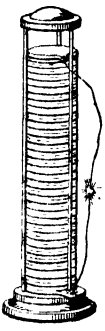
Another energetic double-fluid battery, on a similar principle, was constructed by Professor Callan of Maynooth College. The zinc plate is inserted as usual in a porous cell containing dilute sulphuric acid, and this is introduced into a cast-iron cell charged with a mixture of strong nitric and sulphuric acids. The remarkable efficiency of this combination results from the well-known passivity of cast-iron in these concentrated acids.

In double-fluid batteries, such as those of Daniell and Bunsen, polarization is prevented by the chemical absorption of the nascent hydrogen, but the same end may be attained by mechanical means. In the cell invented by Smee in 1840 the negative plate was of silver coated with finely-divided platinum.

Of the various *standard cells* which have been devised for use in measurements of electromotive force the most important is that of Latimer Clark, of which one form is shown at fig. 5 in the plate. The positive element is zinc or an amalgam of zinc and mercury, the latter being used chiefly in the H form of the cell, and the negative element is pure mercury. The zinc is in contact with sulphate of zinc, and the mercury with mercurous sulphate, which is the depolarizing substance used. In the figure the mercury (Hg) is seen at the bottom of the vessel, and the mercurous sulphate (Hg_2SO_4) rests upon it. Then comes a plug of asbestos, C, separating the mercurous sulphate from the zinc sulphate ($ZnSO_4$). The cork, A, is in contact with the zinc sulphate, and the vessel is sealed by means of a cap, B, consisting usually of marine glue. The cork and cap are penetrated by the zinc rod (Zn), which is immersed in the zinc sulphate, and by a glass tube, G, containing a rod of platinum (Pt) which is immersed in the mercury and serves as the negative terminal of the cell. Clark's standard cell is important because the standard definition of the volt involves it. The definition is contained in the following extract from the London Gazette of Aug. 24, 1894: 'The volt which has the value 10^8 in terms of the centimetre, the gramme, and the second of time, being the electrical pressure that, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampère, and which is represented by 0·6974 ($\frac{1000}{1434}$) of the electrical pressure at a temperature of 15° C. between the poles of the voltaic cell known as Clark's cell, set up in accordance with the specification appended and marked B". The cell indicated in the specification differs somewhat from that shown in the figure. It is set up in a test-tube 2 cm. in diameter and 4 or 5 cm. deep. Directions are given for the preparation of a neutral saturated solution of zinc sulphate and mercurous sulphate in water, prepared with mercurous sulphate in excess, and the mercury and zinc are placed in contact with this solution. The E.M.F. at 15° C. is 1·4345 volt; at $t°$ C. it is given by the formula: $E = 1{\cdot}4345\ \{1 - {\cdot}00077\ (t - 15)\}$. This form is, however, subject to some disadvantages, which are largely obviated in the form first described. The chief disadvantage was the high temperature coefficient and the consequent necessity of determining the temperature with

great exactness. Dr. J. Fleming has adapted the Daniell cell for use as a standard cell, and in this case the temperature coefficient is practically negligible. The Weston Cadmium cell, patented in 1891, is a later type of standard cell with a very small temperature coefficient. It is usually constructed in an H form, one leg containing the positive element, an amalgam of cadmium and mercury, and the other the negative element, pure mercury. The electrolyte is a saturated solution of cadmium sulphate and mercurous sulphate. The E.M.F. is about 1·019 volt. All other cells may be referred to one or other of the types above described.

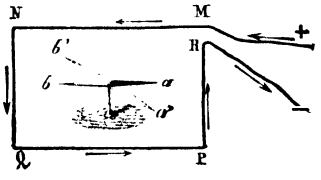
GALVANISM. The part of electrical science which is concerned with currents of electrity was and is known by this name. The name is, however, little used now among writers on electricity. It is derived from Galvani (see GALVANI), an Italian philosopher, who, in a course of experiments on animal irritability, observed the first striking phenomena which led to the discovery of electric currents. The origin of galvanism is due to a trivial circumstance. A physician had in 1790 prescribed a dish of dressed frogs to Madame Galvani, who was at that time an invalid. Some of these animals, which had been skinned by one of the domestics, lay upon the table, when the accidental discharging of an electric machine near it caused a strong contraction of the muscles of the frogs, although they had not been touched by the spark. This was the result of the inductive action of ordinary electricity, familiarly known and often experienced by electricians as the *return shock;* but Galvani, in varying his experiments, found that the same phenomena of muscular contraction may be produced by interposing a metallic conductor between a muscle and a nerve, and he was led to conclude that the muscles of an animal are negatively electrified and the nerves positively, and that the effect of the metal is merely to restore the equilibrium. This theory was combated by Volta, a celebrated professor of natural philosophy at Pavia, who excited similar contractions by making a connection between two parts of a nerve, between two muscles, or between two parts of the same muscle; but to produce the effect two different metals were found by him to be requisite. Hence Volta was led to infer that the electricity is derived, not from the living system, but from the action excited by the contact of the two metals; that the animal matter acts merely as a medium conducting this electricity, and that the effects produced are to be ascribed to the stimulus of the electric fluid passing along the nerves and fibres, as in a shock from a Leyden-jar. A violent controversy long divided the scientific world on this subject, and though Volta was at one time supposed to have gained the victory, later researches have shown that Galvani was correct in asserting the existence of an animal electricity, though he was altogether wrong in attributing all the phenomena he observed to its action. Volta, however, in further demonstration of his views, showed, on good grounds, that plates of different metals, such as silver and zinc, in contact with one another, are excited with opposite electricities; and by employing several pairs of these plates, properly connected together, he discovered in 1800 a mode of greatly augmenting the galvanic energy, and presented to chemistry an unrivalled instrument of research. It consisted of any number of pairs of zinc and copper, or zinc and silver plates; each pair being separated from the adjoining ones by pieces of cloth, nearly of the same size as the plates, and moistened in a saturated solution of salt. The relative position of the metals in each pair was the same in the whole series; that is, if the copper was placed below the zinc in the first combination, the same order was preserved in all the others. The order from the bottom would thus be c z *f* c z *f* c z *f* c z, where c represents a copper plate, z a zinc plate, and *f* the fluid moistening the cloth. Volta's theory of the pile, corrected according to our modern knowledge of the laws of the conservation of energy, is given under VOLTAIC PILE. It is there shown that the exterior plate of copper at the bottom and of zinc at the top are superfluous; and the construction is thus, beginning from the bottom, z *f* c z *f* c z *f* c, and a wire proceeding from the lowest zinc to the uppermost copper plate. The pile, the construction of which will be better understood by the aid of the annexed figure, was contained in a proper frame formed of glass pillars fixed into a piece of thick wood, which afforded the apparatus both support and insulation. The extremities of the instrument thus arranged were found to be in the same electrical state as the single pair of metallic plates, affecting the electrometer and exciting muscular contractions in a similar manner, but in a much greater degree. The opposite ends of the pile were differently excited, the end which began with a zinc plate being positive, and the other negative; and hence, when they were made to communicate by means of a wire from each, electricity flowed from one to the other in a continued current. If the wires were applied to living matter sensations and contractions were excited: they also gave the electric spark. This instrument, at present rarely used, in consequence of more convenient arrangements upon the same principle, has received the name of the *voltaic pile.* Another apparatus for the same purpose was invented by Volta, which he called the *couronne de tasses.* It consisted of a series of glass cups nearly filled with acidulated water or a saline solution. In each cup was placed a plate of zinc and a plate of silver or copper; the plate of silver in the one cup being connected with that of zinc in the other by a thin slip of metal bent into an arc, and the same order being preserved as in the construction of the pile. Several improvements upon this arrangement were soon made by other philosophers; and the discoveries in galvanism multiplied with a rapidity and to an extent which surpass anything before known in the history of science. The word *galvanism* has, as we have remarked above, nearly fallen out of use, at least among those who devote themselves to the cultivation of electrical science. For the information that would have been given at one time under an article with this heading we refer our readers to the following:—ELECTRIC CURRENT (under which a general account of the properties of the current will be found), GALVANIC BATTERY, ELECTRO-MAGNETISM, ELECTRO-METALLURGY, RESISTANCE (ELECTRIC), ELECTRIC LIGHT, also GALVANOMETER and VOLTAMETER.



GALVANIZED IRON is iron plate coated with zinc. This might be done by electro-deposition, and then the iron might be regarded as having been really galvanized, but the coating is commonly effected by heat. The iron article is dipped in dilute acid, hydrochloric, sulphuric, or nitric, so as to expose a fresh metallic surface, then thoroughly washed and brushed, and immersed in a bath of melted zinc. When the surplus zinc has run off the article is cooled, and, if necessary, dressed. Sometimes thick plates are heated in a furnace before dipping, and hammered to remove the scale of oxide which is produced. There are other methods of coating iron with zinc, especially that in which the iron is first tinned by a solution of the chloride of tin, and the plate so prepared is

passed through molten zinc. In this way the zinc is deposited on the article in a crystallized condition, whereas by the ordinary method it is dull and uniform. Galvanized iron, so long as the coating is entire, and so long as it is not exposed to corrosive substances, is very durable, and is extensively used for roofing and other purposes.

GALVANOMETER, an instrument for detecting the existence of, and determining the strength and direction of, an electric current. The property of electric currents which is employed for this purpose is the same in all the various forms of galvanometer. It is that discovered by Oersted, and it is described in our article ELECTRO-MAGNETISM. In 1819 Oersted found that a magnetized needle in the vicinity of an electric current tends to set with its magnetic axis at right angles to the direction of the current. Oersted's fundamental experiment may be exhibited in the following way:—Taking a magnet pivoted so as to be able to turn in a horizontal plane about its middle point, as in the common mariner's compass, bring a straight wire, through which an electric current is passing, near to it. Let the wire be held directly above the pivot of the needle, and in the direction of magnetic north and south, as indicated by the needle when the wire is removed. On bringing the wire into the position that has just been described the needle is immediately seen to deviate from the north-and-south line. If the current is flowing from south to north, the end of the needle that points northwards is deviated to the west of north; if the current is flowing from north to south, that end of the needle turns eastward. A similar effect is produced when a wire through which a current is flowing is placed directly beneath the needle, only that the directions of deviation are reversed. Thus, a current flowing from south to north *below* the needle causes the end of the needle that points northward to deviate to the east. It follows from this that if a current be made to flow simultaneously above the needle in one direction, and below it in the opposite direction, the effects of the two parts of the current conspire to deviate the needle in the same direction. Thus, in the figure, the current, M N Q P R, is flowing through M N, above the needle from north to

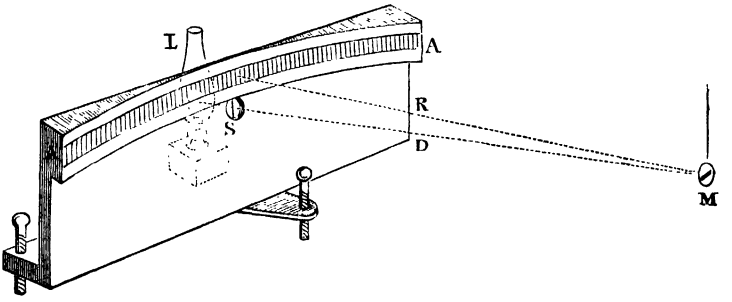


south, and in Q P below it flows from south to north. From both causes the end α of the needle deviates to the east. The effect of the portions N Q and P R of the current is also found, from electro-magnetic laws, to be similar. Thus, every portion of the current tends to turn the needle in the same direction. And the position that the needle takes up depends on the relation between the electro-magnetic forces upon it, and the magnetic attraction of the earth.

It is plain from the figure that if the wire, instead of returning to the battery from the point R, were carried on to M, and thence several times round the circuit M N Q P R, the effect of each coil of the wire would be similar to that of the first. This simple arrangement is often called a galvanometer. By means of the multiplying principle very slight electric currents are detected. It is more properly called a *multiplier* or *galvanoscope*, because, without the modifications as to dimensions of needle and coil, to be described immediately, it is not fitted for more than detecting the existence of a current. The multiplying principle is, however, employed in every form of galvanometer.

The *Astatic Galvanometer*, or properly *multiplier*, is described under the name MULTIPLIER. Of instruments really designed for *measuring* electric currents the most important forms are the *Tangent Galvanometer* and the *Reflecting Galvanometer*.

In the tangent galvanometer a very short magnetic needle is delicately suspended so as to turn in a horizontal plane over a circle graduated to degrees. The point about which the needle turns is at the centre of a vertical coil of copper wire, through which the current is passed. The diameter of the coil is at least ten or twelve times the length of the needle. The needle is, therefore, usually not more than $\frac{1}{2}$ inch long; and for convenience of reading off its deflections long light pointers of aluminium or of glass fibre are cemented to its ends. To use the instrument, it is placed so that the vertical coil of copper wire is in the plane of the magnetic meridian. The current is then sent through the coil, and the angle by which the needle is deflected is read off. It is easy to show that under these circumstances the strength of the current is proportional to the *tangent of the angle of deflection*. Hence the name of the instrument.



In the reflecting or mirror galvanometer of Lord Kelvin a very light magnet, about $\frac{1}{4}$ inch long, and made of fine watch-spring, or a combination of several such magnets, is suspended by a single silk fibre at the centre of the coil of wire through which the current passes. A small mirror, two or three tenths of an inch in diameter, is cemented to the magnet. The magnets, mirror, and cement weigh not more than a third of a grain. The mirror is concave, and has a focus of about 1 metre (40 inches). In front of it, and at that distance, is placed a lamp and scale, as shown in the figure. The light from the lamp passes through the slit S, falls on the mirror M, and is reflected back so as to fall, concentrated owing to the concavity of the mirror, on the scale A A. The lamp and scale are placed in such a position that when the magnet is influenced only by terrestrial magnetism, or by fixed directing magnets that are sometimes used, the reflected light stands at the centre of the scale. The vertical coil of the galvanometer, which is not shown in the figure, is placed so as to be in the plane of the magnetic meridian. When a current is passed through it the needle is deflected. It carries

with it the mirror, and consequently the reflected light is seen to travel along the scale. By means of the divisions of the scale the angle of deflection may be read off. The strength of the current is in this case simply proportional to the angle of deflection, when that angle is small. This instrument has superseded every other for delicate work; for the larger measurements the tangent galvanometer is used. The wire is wound into a coil of peculiar shape, so as to give the highest electro-magnetic effect. It is not all of one gauge, finer wire being used in the interior of the coil, close to the needle, than in the exterior parts. The reflecting galvanometer was invented for use on the Atlantic submarine cables. It was for many years the only instrument with which signals could be read through long submarine lines: and it is still employed, though it is being superseded by the same inventor's siphon recorder.

The *Marine Galvanometer* is also the invention of Lord Kelvin. It is a modification of the reflecting galvanometer, fitted for use at sea; and has proved of paramount importance during the submersion of deep-sea telegraph cables. In the marine galvanometer the magnet and mirror, instead of being suspended by a silk fibre, is attached to a vertical fibre tightly stretched between two springs. This arrangement, while it allows the needle almost perfect freedom to turn about the vertical axis, prevents it from rolling about with the motion of the ship. On account of the magnetism of the iron of all large ships, and on account also of variations of the direction of the ship at sea, it would be impossible to make any use of the earth's magnetism as a directing force for the needle of the galvanometer. The instrument is therefore completely surrounded with soft iron, and under these circumstances it is absolutely shielded, as can easily be proved, from every exterior magnetic influence. Within the soft-iron shell there are placed directing magnets, which are capable of adjustment so as to give the galvanometer any degree of delicacy required. Without this instrument we may safely say it would have been absolutely impossible to lay any of our great submarine lines. During the submersion of a cable, constant communication is kept up through it with the shore. From the very beginning till the very end of the operation of laying the cable, currents are kept flowing through the wire, and by means of the galvanometer it is ascertained whether the cable passing overboard is in good order or not. If a *fault* has passed overboard, by testing with the assistance of the galvanometer its existence is immediately indicated, and the very point at which the fault may be expected to be found is determined. The cable is then, if necessary, hauled back into the ship till the fault is reached and cut out; and after *splicing*, the perfection of which is again tested by the galvanometer, usually with the assistance of the electrometer also, the submersion may again be proceeded with.

Of other forms of galvanometer the *sine galvanometer* may be mentioned. It is similar to the tangent galvanometer, but is differently used. There are also various kinds of *indicators*, which show the existence of a current without measuring it. Descriptions of such instruments will be found in detailed works on electricity.

GALVESTON, a city and flourishing seaport of Texas, United States, situated at the north-east extremity of Galveston Island, at the mouth of the bay of the same name, about 450 miles south by west from New Orleans. The chief buildings are the town-hall, a number of churches, a high-school, the Texas Supreme Court, the custom-house, the school of medicine of the State university, and the Roman Catholic University of St. Mary. Among the industrialestablishments are cotton-compresses, cotton-mills, cotton-seed-oil mills, foundries, breweries, &c. Galveston is a great cotton port, the amount exported in 1903 being 2,084,530 bales valued at £23,092,126. The other exports comprise cotton-seed oil, meal, and cake, wheat, maize, cattle, logs, lumber, &c. The total exports in the same year were valued at £28,674,346. The imports are of comparatively little importance. To improve the harbour several miles of stone jetty have been constructed. The depth of water is fully 27 feet, having been doubled since 1872. A terrible hurricane and flood in 1900 caused the loss of thousands of lives and immense damage to property. Pop. in 1890, 29,084; in 1900, 37,789.

GALWAY, a county of Ireland, in the province of Connaught, bounded north by Mayo and Roscommon; east by Roscommon, King's County, and Tipperary; south by Tipperary, Clare, and Galway Bay; and west by the Atlantic Ocean; area, 1,502,362 acres. Only about one-twelfth of the total area is arable, fully one-half is in grass and pasture, and one-third is bog, marsh, or barren moor. In the north-west, or district of Connemara, it is rugged and mountainous, and almost in a state of nature; in the east, level but extensively covered with bog; and in the south, fertile and tolerably well cultivated, producing some excellent wheat, while elsewhere the principal grain crops are barley and oats. Lough Corrib, which lies almost wholly within it, is the third largest lake in Ireland. Lough Mask also partly belongs to it. Its minerals include lead, limestone, marble, and beautiful serpentine. The county is more pastoral than arable, and the cattle and sheep are numerous and good. The fisheries are of some importance. The principal manufactures are coarse woollens and linens. The county returns four members to Parliament. Pop. (1891); (1901), 192,146.

GALWAY, a seaport of Ireland, capital of the above county, and now a county in itself, at the mouth of the Corrib, on the north side of Galway Bay, and the western terminus of the Midland Great Western Railway, 117 miles west of Dublin. The river is here crossed by three bridges. The town consists in its older parts of narrow, irregular streets, lined with antique houses, many of them entered by arched gateways and open courts, and once occupied by the respectable classes, but now crowded with a pauper population; in the more modern parts the streets are spacious and the houses both substantial and handsome. The chief edifices are the interesting Episcopal church of St. Nicholas, in the decorated English style; Presbyterian, Methodist, and several Roman Catholic chapels, besides monasteries and nunneries; a town court-house and county court-house; the Queen's College, a beautiful Gothic structure; grammar and other schools, a custom-house, county infirmary, two barracks, workhouse, and prisons. There are foundries, saw-mills, corn-mills, a distillery, brush-factories, marble-cutting works, &c. The trade, though once important and favoured with an excellent harbour, has much declined, but has in recent years shown some improvement. The chief exports are provisions, wool, and marble. Galway returns one member to Parliament. Pop. in 1891, 16,959; in 1901, 16,245.

GALWAY BAY, a large bay on the west coast of Ireland, between county Galway on the north and county Clare on the south, about 30 miles in length and 10 in breadth. Opposite its entrance are the Arran Islands, and there are numerous small islands in the bay itself.

GALYZIN. See GALITZIN.

GAMA, Dom Vasco da, born ab. 1469 at Sines, a small seaport of Portugal, of a noble family, was the first navigator who made the voyage to the East Indies by the Cape of Good Hope. As soon as the pupil of Henry the Navigator, Emmanuel the Fortunate, had ascended the throne, he determined to carry into execution the project of sailing to India round the Cape of Good Hope, for which great preparations had been already made by his predecessor, John II. By his command four vessels, manned with 160 marines and sailors, were fitted out, and Gama was intrusted with the chief command. July 8th, 1497, Gama set sail from Lisbon, and on November 22, doubled the Cape of Good Hope. In the beginning of 1498 he reached the eastern coast of Africa, and, March 10, entered the harbour of Mozambique, where his crew were in great danger on account of the hostility of the inhabitants to Christians. His guns saved him. He left Mozambique on 29th March, and arrived on 24th April at Mombaza, where he met with similar enmity. His reception at Melinda, which he reached on 15th April, was more friendly. The king gave him an experienced pilot, and all the nautical information at his command. Holding his course straight towards the coast of Malabar Gama arrived in May at Calicut. On his arrival he was favourably received; but the Mohammedan merchants who visited Calicut, prompted by motives of commercial jealousy, found means to disturb this amicable understanding. Gama, however, restored it by his resolution and prudence. The Zamori (Samudri-Raja, king of the coast), the Hindu sovereign of Calicut, afterwards sent him a letter for King Emmanuel. In August he set out on his return journey, but did not reach Lisbon till the August of the following year. On his arrival at the capital the king bestowed honours and rewards on Gama and his bold companions. Gama was named Admiral of the Indies and received the title of Dom, with an annual pension and extensive privileges in Indian commerce.

In the year 1502 Gama was placed at the head of a powerful fleet, with which he took vengeance on the sovereigns of Eastern Africa who had impeded his former voyage, and provided for the security of future voyagers by founding establishments at Mozambique and Sofala. He also inflicted signal reprisals on the town of Calicut, where the Portuguese residents had been massacred, and as the result of his negotiations with the King of Cochin established the first Portuguese factory in the Indies. He re-entered the port of Lisbon on 20th December, 1503. After remaining twenty years in obscurity Gama was appointed Viceroy of India by King John III. in 1524. He left the harbour of Lisbon with fourteen vessels. Immediately after his arrival he visited several small colonies, using all means in his power for their defence and the preservation of the authority of the Portuguese arms among the natives; but he had scarcely administered his office for the space of three months when he died, December 24, 1524, at Goa.

GAMALIEL. Two persons of this name are mentioned in Bible history. The first, Gamaliel, the son of Pedahzur, in the book of Numbers i. 10; ii. 20; vii. 54, 59; x. 23, as prince or head of the tribe of Manasseh. The other and better known Gamaliel is mentioned twice in the Acts of the Apostles. In both passages he appears as a learned doctor of the law, of the sect of the Pharisees. From the one we learn that he was the preceptor of St. Paul, who was brought up in Jerusalem 'at the feet of Gamaliel.' In the other we find him advising the council or Sanhedrim in regard to their treatment of the apostles, and it is the advice given on this occasion which has rendered him famous. 'If this council or this work,' he said, 'be of men it will come to nought, but if it be of God ye cannot overthrow it, lest haply ye be found even to fight against God.' Ecclesiastical tradition makes Gamaliel become a Christian, and relates that he was baptized by St. Peter and St. Paul; but the story does not appear to be supported by any evidence. He has been identified by scholars with Gamaliel, the son of Simeon and grandson of Hillel, who was president of the Sanhedrim under Tiberius, Caligula, and Claudius, and on his death, said to be about eighteen years before the destruction of Jerusalem, was succeeded in his presidency by his son Simeon, who perished in the siege.

GAMBETTA, Léon Michel, a French orator and statesman, was born in 1838 at Cahors, of a family of Genoese extraction. He was educated first with a view to entering the church, but this design was given up in favour of the law. After a course of study at the *lycée* of his native town he therefore repaired to Paris, becoming a member of the metropolitan bar in 1859. For a number of years his days were spent in the law courts, occupied in many instances in the defence of liberal journalists who had rendered themselves obnoxious to the imperial government; his evenings being passed in keen debate in the cafés frequented by the more notable members of the republican party. In November, 1868, he may be said to have gained the leadership of that party by his famous speech in defence of Delescluze, the editor of the Reveil, who was prosecuted by the government for starting a subscription for a monument to the memory of a noted republican killed in the massacre consequent on the *coup d'état* of December, 1851, which placed Louis Napoleon on the imperial throne. Gambetta was invited to stand as representative for both Paris and Marseilles in the elections of 1869, and he chose to represent the southern city. In the Chamber of Deputies he showed himself on all occasions an irreconcilable opponent of the empire and its measures, especially declaiming fiercely against the policy which was fast hurrying France into a war with Prussia. On the downfall of the empire, which followed the surrender of Napoleon to the Germans at Sedan, in September, 1870, a government for the national defence was formed, in which Gambetta was nominated to the office of minister of the interior. When the Germans had fairly encircled Paris, he left that city in a balloon, and set up his headquarters at Tours. From this place, with all the powers of a dictator, he for a short time organised the fiercest resistance against the invaders, raising army after army, only to be crushed in close succession by the enemy. After the close of the disastrous war he started a newspaper, La République Française, in which, as well as in the Chamber of Deputies, he defended the republic against the machinations of the Bourbon and Bonapartist parties, who had the support of President Macmahon. Gambetta held office in several short-lived ministries, but it was not until November, 1881, that he could be prevailed on to accept the premiership. The sweeping changes proposed by him and his colleagues, including the *scrutin de liste*, or voting by whole departments, speedily brought a majority against him, and after a six weeks' tenure of office he had to resign. The accidental discharge of a pistol was the cause of his death, which occurred at Paris on the 31st December, 1882.

GAMBIA, a British colony in West Africa, occupying portions of territory at the mouth of the river Gambia, some of its islands, and, according to recent arrangements with France, ten kilometres or about six miles of land on either bank for a distance of 250 miles from the sea, and the navigable waters of the

Vintang Creek. It thus forms a narrow strip running through French territory; total area, estimated at about 2700 square miles. The principal settlement is Bathurst, at the mouth of the river; another is M'Carthy's Island, 180 miles, following the windings of the stream, from its entrance. Besides the settlements above mentioned, there are factories and stations at intervals along both banks of the stream, and there are also some large native towns at no great distance from it. There is comparatively little fertile land in the colony, and what agriculture there is is carried on in a very primitive manner. Rice and other kinds of grain are grown, but not in sufficient quantity to satisfy the local demand. Gambia differs very little from the other West African settlements in point of unhealthiness. There is considerable sickness during and after the rains, but most of the British merchants pass the worst months of the year (July to October) in England. The position of Bathurst, the seat of government, is very unhealthy in the rainy season. There is a certain number of Anglican, R. Catholic, and Wesleyan schools in the colony. Cotton cloth is manufactured to some extent by the natives, who also prepare palm-oil, build boats, &c. The revenue of the colony averages about £48,000. The principal exports are ground-nuts, rubber, bees'-wax, ivory, hides, gold, palm-oil, &c. The value of imports in 1902 was over £248,000, and the exports amounted to somewhat more. A light government steamer runs weekly to and from M'Carthy's Island. Gambia is a crown colony under an administrator, who is assisted by an executive and a legislative council. The population in 1901 was 13,500, including about 200 whites, the remainder being chiefly negroes.

GAMBIA, a river of West Africa, which rises in a mountainous district in Foota Jallon, about lat. 11° 30′ N.; lon. 11° W., whence it flows N.W. and W. towards the Atlantic, into which it falls after a course of about 450 miles. In its earlier course it flows through a rich and picturesque country belonging to France, afterwards becoming British. The soil adjoining the river is in some parts extremely fertile, yielding rice and tobacco in great abundance, while the immediate banks are clothed with the most beautiful trees. It is navigable for about 300 miles up from its mouth. See preceding article.

GAMBIER ISLANDS, a group of small islands of the South Pacific, about lat. 23° 8′ S., and lon. 134° 55′ W. They are all surrounded with coral reefs, and though low have a general slope from east to west. The vegetation is luxuriant, and the native birds are numerous, but not one indigenous quadruped is known. The natives are a well-formed race, and have made some progress in civilization. On Mangareva, the largest of the group, some French missionaries settled in 1834, and the islands now belong to France. The total population is about 2300.

GAMBIR, or GAMBIER, called also *terra japonica*, an astringent substance obtained from the *Uncaria gambir*, a tree of the family Cinchonaceæ, cultivated in Sumatra and other islands of the Malay Archipelago. It is obtained from the leaves by boiling or infusing them in water, inspissating the resulting fecula, and forming into cakes. The Chinese use it for chewing, and in Europe it is employed in dyeing and tanning, also medicinally. It is mostly exported from Singapore. It is often considered as one of the varieties of catechu (which see).

GAMBLING. See GAMING.

GAMBOGE, a gum-resin obtained from *Garcinia Hanburyi*, a tree of the order Clusiaceæ, growing in Siam, Cochin-China, and other parts of the East. It was brought to Europe from China by Admiral Van Neck about the beginning of the seventeenth century, and was first described in 1605. This plant gives out a yellowish milky juice when incisions are made in the stem. The juice which issues is collected sometimes in bamboo canes, and constitutes *pipe* gamboge; another variety seems to be produced by rolling, and is in solid cylinders: sometimes the juice flows into cocoa-nut shells and is poured into basins, where it solidifies, and forms *cake* gamboge; it is also got in lumps or amorphous masses. It is of very various degrees of purity. Externally gamboge is lustreless, of a dirty greenish yellow or brown, covered with dust, opaque, without odour. It has an acrid taste, which is but slowly developed. It breaks with a conchoidal fracture, and then exhibits a fine resinous lustre, and a brownish-yellow colour, giving a brilliant orange-yellow powder. When heated, it emits a peculiar odour, volatilizes without melting, and undergoes decomposition. It forms a yellow emulsion with water, which is used in painting, and for staining wood in imitation of box; it is one of the ingredients in the gold-coloured varnish laid on brass work, and it has also been used for staining marble. When taken into the stomach it acts as a drastic purgative, but is seldom administered alone. In doses of a dram, or even less, it produces death. Ceylon gamboge is obtained from *G. Morella*.

Gamboge contains from 68 to 79 per cent of resin, and from 19 to 27 of gum, the rest consisting of woody fibre, moisture, and sometimes starch. When treated with water and alcohol or ether it can be almost completely dissolved. The resin is best separated from the gum by ether. It is of a fine red colour, has no taste or smell, and reacts with the alkalies to form soluble salts, and with the alkaline earths to form salts insoluble in water. From its acid and salt forming properties this resin has been called *gambogic* acid.

GAME, in general, signifies any diversion or sport, more especially any sport or diversion carried on according to regular rules. Games are classed in various ways, as into those of address or skill and those of hazard or chance; athletic games, &c.; but the various elements may enter into a single game. See GAMES, GAMING, also the individual articles.

GAME LAWS, laws relating to the killing of certain wild animals pursued for sport, and called game. The game laws of England are a relic of the forest laws, which in the time of the Norman kings were so oppressive; it being under the Conqueror as great a crime to kill one of the king's deer as to kill one of his subjects. A certain rank and standing, or the possession of a certain amount of property, were for a long time qualifications indispensably necessary to confer upon any one the right of pursuing and killing game. By the Game Act, 1 and 2 Will. IV. cap. xxxii., the game laws were greatly modified, the necessity for any qualification except the possession of a game certificate being then abolished, and the right being given to any one to kill game on his own land, or on that of another with his permission. Every uncertificated person selling game is also required to take a yearly license. The animals designated as game by this act are hares, pheasants, partridges, grouse, heath-game or moor-game, black-game, and bustards. These animals (with the exception of hares) are not allowed to be killed at all times, there being a certain season of the year—the close season—during which all and sundry are prohibited from killing game. The close season for partridges is from 1st February to 1st September, for pheasants from 1st February to 1st October, for black-game from 10th December to 20th August, except in the New Forest in Hampshire, or in the

counties of Somerset and Devon, in which the close period is 10th December to 1st September; for grouse or red-game from 10th December to 12th August; for bustard from 1st March to 1st September (the days named being in each case excluded). A close time for hares was not fixed by this act, but an act of 1892 provides that hares (except foreign ones) are not to be sold from March 1st to July 31st. Any person killing game on Sunday or Christmas-day is liable to a penalty of £5. A game certificate is also necessary to enable a person to kill deer, woodcocks, snipes, quails, land-rails, and rabbits; but the owner or occupier, or any person authorized by him, may kill hares or rabbits on his own inclosed ground without a certificate. Whoever trespasses by day on the lands of another in pursuit of game or any of the above-mentioned animals, is liable to the fine of £2, and when five or more go together each is liable to the penalty of £5. Night poaching is a graver offence than day poaching; any person found guilty of trespassing in pursuit of game between the first hour after sunset and the last before sunrise, being for the first offence liable to imprisonment with hard labour for three months, and in case of not then finding security for good conduct to six months' further imprisonment. And the penalty is increased for each offence. The use of violence against owner or keeper aggravates the offence, and night poaching by armed gangs is very severely punished. By the act 23 and 24 Vict. cap. xc., 13th August, 1860, the duties on certificates for killing or dealing in game are declared to be excise duties, and are regulated as follows:—For a license in Great Britain, or certificate in Ireland, to each person using a dog, gun, net, or other engine for taking or killing any game whatever, if taken after 5th April and before 1st November, to expire on 5th April in the following year, £3; if to expire on 31st October of the same year, £2; from 1st November to 5th April, £2; license to servant, if person authorized to kill game, £2; license to deal in game in England, Scotland, or Ireland, £2. By 33 and 34 Vict. cap. lvii., a duty of 10s. is imposed for a license to make use of a gun. By 43 and 44 Vict. cap. xlvii. (1880), every occupier of land has a right, as inseparable from and incident to the occupation of the land, to kill and take ground game (hares and rabbits) thereon, concurrently with any other person entitled to take and kill it on the same land, provided that (*a*) he and one other person authorized by him in writing shall be the only persons entitled under this act to kill ground game with firearms; (*b*) no person is to be authorized by him except a member of his household resident on his land, a person in ordinary service on such land, or any other person paid by him to take and kill ground game. By this act, also, all agreements in contravention of the right of the occupier to destroy ground game are declared void. Game can be legally taken only in certain ways. Poison and spring-traps are not allowed to be used.

GAMES, in antiquity, were public sports, exhibited on solemn occasions, in which various kinds of contests were engaged in. Such, among the Greeks, were the Olympic, Pythian, Nemæan, &c., games, and among the Romans the Apollinarian, Circensian, Capitoline, &c., games. The Grecian games were national festivals attended by spectators and competitors from all parts of Greece. They consisted of chariot races, running, wrestling, and boxing matches, &c., and to be victorious in one of these contests was esteemed one of the highest honours which a Greek citizen could attain. The Roman games (*ludi*) were held chiefly at the festivals of the gods, of which kind were those already mentioned, together with the *Floralia*, *Compitalia*, *Megalesia*, &c. Or they might be exhibited by private persons to please the people, as the combats of gladiators, theatrical representations, combats of wild beasts in the amphitheatre, &c. See OLYMPIC, PYTHIAN, NEMÆAN, &c., GAMES; also CIRCUS.

GAMING, or GAMBLING. The practice of betting or gambling upon games of chance, as tending to promote idleness, dishonesty, and other vices, and not unfrequently directly associated with fraud, is generally considered contrary to the interests of society, and is frequently prohibited by law. The collateral practices of betting on events, taking shares in lotteries, &c., are of a similar nature, and liable to like treatment. The practice of civilized communities in regard to these acts has been far from uniform. The odium of gambling has sometimes been attached to games perfectly innocent in themselves, and these games have been prohibited to the manifest prejudice of the law, which has thus been brought into dishonour and contempt. At other times, governments, tempted by the facilities of sharing in the dishonest gain, have openly and shamelessly encouraged gambling by licensing gaming-houses, or instituting lotteries under their own authority. (See LOTTERY.) In France, public gaming-tables were suppressed from 1st January, 1838. Previous to the formation of the new German Empire gambling was encouraged in both of the ways referred to in several of the principalities of Germany. Baden-Baden, a watering-place in the Grand-duchy of Baden, and Homburg, then in the landgravate of Hesse-Homburg, were until comparatively recent times the two most famous resorts in Europe of the frequenters of gaming-tables. Since the suppression of gaming in these places, after the formation of the empire (viz. on 31st December, 1872), the principality of Monaco in Italy has become the last public resort of this species of gambling in Europe.

We give an outline of the principal acts passed against gaming in Great Britain. In the time of Edward III. certain games were forbidden by proclamation, but with the view chiefly of encouraging archery. Henry VIII. also made proclamation against unlawful games, among which were included dice, cards, and bowls. The statute 33 of Henry VIII. cap. ix. prohibits the keeping of any common house for dice, cards, or any unlawful games under penalties of 40*s.* per day for keeping the house, and 6*s.* 8*d.* per time for playing in it. Artificers, labourers, apprentices, or servants, are prohibited from playing at tennis, dice, cards, bowls, &c., out of Christmas-time, on pain of 20*s.* for every offence. At Christmas they are only to play in their master's house or presence; but any nobleman or gentleman having an estate of £100 per annum may license his servants to play in his house or garden. Gaming-houses were licensed in London in 1620. By 16 Charles II. cap. vii. (1663), any person fraudulently winning money by gaming is to forfeit treble the amount, and any person losing more than £100 at cards, &c., on *tick* at one sitting is not bound to pay it, and the winner forfeits treble the amount. By 9 Anne, cap. xiv. all notes, bills, bonds, &c., given for money won by gaming are void, and any person paying a loss of more than £10 may recover it within three months as a common debt; and if the loser do not sue, any other person may do so. By 5 and 6 William IV. cap. xli. such notes are declared to be void between the parties, but not in the hands of purchasers or endorsers. Gamblers having no ostensible means of living may be committed to prison. 9 George II. cap. lxi., and 30 George II. cap. xxiv., inflict penalties on the keepers of public-houses for permitting gaming. By 12 George II. cap. xxviii., 13 George II. cap. xix., and 18 George II. cap. xxxiv.,

the games of faro, basset, ace of hearts, hazard, passage, rolly-polly or roulette, and all other games with dice, except backgammon, are prohibited under a penalty of £200 for the keeper of the gaming-house, and £50 a time for the players. The act 8 and 9 Vict. cap. cix. repeals 16 Charles II. cap. vii., and some other acts, also so much of the act of Henry VIII. as prohibits bowling, tennis, or other games of skill. It also inflicts the penalty of £100 in addition to the penalties of the act of Henry VIII. on any person conducting in any manner the business of a common gaming-house, with the alternative of six months' imprisonment with or without hard labour, and by act 17 and 18 Vict. cap. xxxviii. the maximum penalty is increased to £500. By the former act penalties are inflicted for keeping billiard or bagatelle tables without a license. All contracts, by way of gaming or wagering, are made void, and any person fraudulently winning money or valuables by gaming shall be deemed guilty of obtaining it by false pretences. No suit-at-law can be brought to recover a deposit from a stakeholder, but this does not apply to any prize at any lawful sport. Act 16 and 17 Vict. cap. xix. provides that betting-houses shall be considered gaming-houses within the meaning of 8 and 9 Vict. cap. cix. Act 17 and 18 Vict. cap. xxxviii. refers especially to the metropolis, and prohibits under a penalty of £100 the barring of the door, or in any way obstructing the entrance of an authorized officer into a gaming-house, and imposes a penalty of £50 on any person found in such house giving a false name or address. By an act which was passed in 1873 (36 and 37 Vict. cap. xxxviii.), any person betting in the street or any public place is declared to be a rogue and vagabond. 37 and 38 Vict. cap. xv. further imposes penalties on persons advertising or sending letters, circulars, telegrams, &c., as to betting, and additional restrictions on betting have since been introduced.

GAMUT (Italian, *gamma*; French, *gamme*), the name given in the system of Guido d'Arezzo to the entire series of musical tones in the natural order of ascent or descent. The musicians of the eleventh century made use, to distinguish a succession of tones of several octaves, of the following scale:—*A*, *B*, *C*, *D*, *E*, *F*, *G*, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *aa*, *bb*, *cc*, &c. A represented the lowest note in their instruments; a lower note having been introduced, the Greek gamma (Γ) was taken to represent it in order not to repeat any of the previous signs. The gamma being thus the first note of the scale, its name was taken to represent the whole. The *ut* is the first word of a Latin hymn formerly used in singing the scale.

GANDAMAK, a small town of Afghanistan, situated in the valley of the Cabul, about 60 miles E.S.E. of Cabul. Here, during the disastrous retreat from Cabul in 1842, the last remnant of the British force was massacred, with the exception of one man, and here too in 1879 a delimitation treaty was concluded between Britain and Afghanistan.

GANDIA, a town of Spain, in the province, and 34 miles south by east of Valencia, on the Alcoy, and surrounded by old walls. It is well built, and has a handsome Gothic collegiate church and a magnificent palace. It has a port at the mouth of the Alcoy, 2½ miles distant. Pop. (1897), 9989.

GANDO, a kingdom of the Western Soudan, intersected by the Niger, and inhabited chiefly by Fellatahs, with a capital of the same name. It is a most fertile district, the rain being plentiful. Mohammedanism is the prevalent religion. Gando is now comprised partly in British (Northern Nigeria), partly in French territory. Pop. estimated at 5,000,000.

GANESA, an Indian god, the son of Siva and Párvati, represented by a figure half-man, half-elephant, having an elephant's head with a single tusk. He wears a crown, and his ears are adorned with jewels. In compensation for his deformity Brahma appointed him to a highly honourable place among the gods. He is the god of good luck, and is consequently invoked at the beginning of all enterprises. He is also considered the patron of learning, and is supposed to be able to prevent literary fame if his worship is not attended to. He is also invoked on the occasion of marriages. There are not many temples dedicated to Ganesa, and he has no public festivals, but his image stands in almost every house, and is invoked with offerings and ceremonies both by men and women.

GANGA, in Hindu mythology, the personified goddess of the river Ganges.

GANGES (called by the Hindus *Ganga*, from a verb meaning to go), one of the greatest rivers of Asia, which rises in the Himalaya Mountains, in the province of Gurhwal. It is formed by the junction of two head streams, called respectively the Bhagirathi and the Alaknanda, which unite at Deoprag, 10 miles below Srinagar, 1500 feet above the level of the sea. The Bhagirathi is usually considered the source of the Ganges from its being a sacred stream in Hindu mythology; but the material claims of the Alaknanda are preferable, as it flows farther and brings a larger volume of water to the junction. At Hardwar, about 120 miles N.N.E. of Delhi, and about 30 miles below the junction of the head streams, the river is only 1000 feet above sea-level. Here it enters the great valley of Hindustan, and flows in a south-east direction till it discharges itself by its numerous mouths into the Bay of Bengal, a distance, exclusive of windings, of fully 1100 miles. Its delta belongs to it in common with the Brahmaputra. During its course it is joined by a number of large rivers, the principal of which are the Jumna and Sone, joining on the right bank; the Ramganga, Gumti, Gogra, Gandaki, and Koosi, on the left bank. Its utmost breadth is about 3 miles, with a depth of about 30 feet in the dry season and 60 in the wet. Its junction with the Jumna at Allahabad forms the most venerated place of Hindu ablution. Its descent is computed at 4 inches per mile; its current in the dry season is less than 3 miles an hour; in the wet season 5 or 6, and in particular circumstances and situations 7 or 8. The periodical inundation of the Ganges commences about the end of April with the tropical rains. It rises gradually till it attains, near the commencement of the delta, a height of 32 feet above its ordinary level. By the end of July the flat country of Bengal is overflowed to the extent of 100 miles in breadth, leaving visible little but tops of trees and villages, which are often built on artificial mounds above the height of the inundation. After the middle of August the water begins to recede, and decreases till the period of the next inundation. The quantity of water discharged into the ocean is estimated to average 500,000 cubic feet per second during the flood season, and 100,000 during the remaining eight months of the year. Its current brings down a great quantity of mud, and the Ganges, like the Nile, has a very wide delta, extending east and west from 80 to 200 miles, and commencing about 200 miles, or 300 by the course of the river, from the sea, and intersected by numerous branches. A part of it is an uninhabited region, called Sunderbunds or Sundarbands, overgrown with forests and abounding with tigers and crocodiles, to which it is almost wholly abandoned. The navigation through the channels in the Sunderbunds is chiefly effected by means of the tides. The whole coast of

the delta is a mass of mud banks continually shifting. The westernmost branch of the Ganges, called the Hugli, is the only branch commonly navigated by ships; and vessels drawing 26 feet can be safely piloted up to Calcutta. The main branch on the east is joined by the Meghna or main branch of the Brahmaputra, about 40 miles from the Bay of Bengal. Some of the principal cities on the Ganges and its branches, ascending the stream, are Calcutta, Murshedabad, Bahar, Patna, Benares, Allahabad, and Cawnpore. The Ganges is navigable for boats of a large size nearly 1300 miles from its mouths. It is a great feeder of irrigation and navigation canals. (See GANGES CANAL.) Its length, with deviations, is calculated at about 1500 miles.

It is an imperative duty of the Hindus to bathe in the Ganges, or at least to wash themselves with its waters, and to distribute alms, on certain days. The Hindus believe that this river rises immediately from the feet of Brahma, and that it possesses great miraculous powers on account of its divine origin. Whoever dies on its banks, and drinks of its waters before his death, is thought to be exempted from the necessity of returning into this world and commencing a new life. Whenever, therefore, a sick person has been given over by the physicians, his relations hasten to carry him to the bank of the Ganges, in order that he may drink of the holy water, or be immersed in the river. Such as live too far from the river to admit of this, always preserve some of the precious water, as a sacred treasure, in a copper vessel, that it may be given them in the hour of death. This water is, therefore, a considerable article of commerce in India. It is also customary, after the dead have been burned, to preserve the remains of the bones and the ashes until an opportunity offers of throwing them into the Ganges. That part of the Ganges which lies between Gangotri and Sagor Island, below Calcutta, is held particularly sacred. Wherever the river runs from south to north, contrary to its usual direction, and wherever it joins other rivers, it acquires a more peculiar sanctity.

GANGES, a town of France, in the department of Hérault, near the left bank of the river Hérault, beautifully situated in a fertile plain, studded with country seats, and inclosed by mountains, 25 miles N.N.W. of Montpellier. Its most conspicuous object is an old castle of very picturesque appearance crowning a commanding height. Pop. (1896), 4216.

GANGES CANAL (UPPER), one of the canals of Hindustan, a lateral canal for purposes of irrigation and supplementary navigation, extending on the right of the Ganges from Hardwar to Cawnpore. The trunk of the canal measures 350 miles, the branches to Hamirpur, Fategarh, Bulandshahar, and Coel, 460. The canal was finished in 1854.—The LOWER GANGES CANAL, which is a sort of continuation of the Upper, branches off from the river at Narora, and is navigable as far as Gopalpore and Jeyra. This scheme, which was calculated to embrace about 550 miles of main canal, was begun in 1873, but has only partially been carried out.

GANGRENE. See MORTIFICATION.

GANGS, AGRICULTURAL. The act 30 and 31 Vict. cap. cxxx. was passed to regulate the employment of gangs of labourers in the fen district of England. The labourers, consisting mostly of boys and girls, were brought from the neighbouring counties. They were often harshly treated, and in returning home their association was attended with immoral and degrading consequences. The act provides that no child under eight years of age shall be employed by a gang-master; that no female shall be employed in the same agricultural gang with males; and that no female shall be employed unless a female, licensed as a gang-master, be present.

GANGWAY, a word used in various senses, especially in connection with ships. It may be, for instance, a narrow platform or range of planks laid horizontally along the upper part of a ship's side from the quarter-deck to the forecastle, in ships that are deep-waisted, for the convenience of walking more expeditiously fore and aft, by obviating the necessity of descending into the waist. It is fenced on the outside by iron stanchions, and ropes or rails. The *gangway* is also that part of a ship's side, and the opening in her bulwarks, by which persons enter and depart. It is provided with a sufficient number of steps or cleats, attached to the ship's side, and sometimes furnished with a railed accommodation ladder. Almost any means of communication laid between a ship's side and the shore may be so called. The word is also used to signify a narrow passage left in the hold, when a ship is laden, in order to enter any particular place as occasion may require, whether to examine the situation of the provisions or cargo, to discover and stop a leak, or to bring out any article that is wanted.—Finally, *gangway* implies a thoroughfare or narrow passage of any kind. Thus, in the House of Commons, in which the benches are arranged in two long rows, one on either side, from the chair to the bar, the *gangway* is a narrow passage dividing both rows midway, the seats nearer the chair being said to be *above the gangway*, and being occupied by ministers and ex-ministers and their supporters.

GANJÂM, a decayed town of India, in the Madras Presidency, formerly capital of the district of the same name, near the coast of the Bay of Bengal. It stands on an elevated portion of the plain. It was at one time a flourishing place, but the town gradually became almost deserted since 1815, in consequence of a destructive visitation of fever. The government salt manufacture is the chief industry, and the trade is mostly in rice. The sanitary condition has latterly been much improved. Pop. (1891), 4695.—The district is one of the most productive in the Madras Presidency, yielding rice, cotton, sugar, rum, and pulse. Amongst the exports are gums, drugs, wax, ghee, salt, &c. The capital is Berhampur. Area, 8370 square miles; pop. (1891), 1,896,803.

GANNAT, a town of France, in the department of the Allier, on the Andelot, 34 miles south by west of Moulins, finely situated at the foot of smiling slopes, covered with woods and vineyards. It has an ancient and interesting church; and has tanneries and breweries, and a trade in corn and wine. Pop. (1896), 5036.

GANNET (*Sula*, Brisson), a genus of birds forming the type of the family Sulidæ of the order Steganopodes. The common gannet is *S. bassana*, and is also known as the solan goose. This bird is about 3 feet in length, and 6 in breadth from tip to tip; the whole plumage is of a dirty white, inclining to gray. The eyes are of a pale yellow, and surrounded with a naked skin of a fine blue colour. The bill is 6 inches long, and furnished beneath with a kind of pouch, like that of the pelicans, with which birds the gannet was classed by Linnæus. The order Steganopodes (Natatores of other systematists) includes those birds that have all the four toes united by one web. The gannets are birds of passage, appearing in Great Britain in the summer, arriving about March, and departing in August or September. They principally feed on herrings; and hence it is probable that their arrival and departure are influenced by the motions of these fish, as they are constantly seen attending them

during the whole of their circuit round the British Islands. They migrate to the southward in the winter, and appear on the coast of Portugal. In the breeding season these birds retire to high rocks on uninhabited islands and elsewhere, and are found in immense numbers on the Bass Rock in the Firth of Forth, on Ailsa Craig in the Firth of Clyde, on St. Kilda and adjacent islets, on certain rocky islets of the Orkneys, and on Lundy Island in the Bristol Channel, the only known English breeding-place of these birds. The dreary precipices on which they breed are almost covered, during May and June, with nests, eggs, and young birds; and when the old birds are disturbed, the air is darkened with the vast flocks that rise from their nests. These nests are generally formed of sea-weed, turf, grass, &c. The female lays only one egg, though, if it be removed, she will deposit another. The young are much darker than the old birds. They remain in the nest until they have nearly attained their full size, becoming extremely fat. In this state they are much esteemed, though their flesh is strong and fishy. In St. Kilda they form no unimportant part of the food of the inhabitants. The taking of these birds is attended with some danger. The persons employed in it are generally let down by a rope from the top of the precipices, and thus hang suspended at very great heights. When the person thus suspended has secured all the birds within his reach, he is raised and lowered as occasion requires; and when he has got as many as he can in one quarter he removes to another. Outside of the British area the gannet breeds in the Faroes, on the coasts of Iceland, and in some localities about the mouth of the St. Lawrence. Besides the British species, two species occur in the southern hemisphere. See illustration at ORNITHOLOGY.

GANOID FISHES, an order of fishes founded by Agassiz on the character of the scales of certain fossil fishes, which are bony and lustrous (Gr. *ganos*, brightness). The ganoids were most numerous in Palæozoic and early Mesozoic times, and are now represented by some seven genera. The characters of the order are not sharply defined, the species agreeing in several respects on the one hand with the osseous fishes, on the other with the cartilaginous fishes (Sharks and Rays). The aortic bulb contains several rows of valves; the optic nerves decussate, and the intestine is provided with a spiral valve, which in the genus *Lepidosteus* is rudimentary. The edges of the gills are free, and are closed in with an operculum or gill-cover; the air-bladder is connected with the pharynx by a narrow duct, and there is no cloaca. The urinary and reproductive organs communicate, and the ventral fins are always abdominal when present. The skeleton varies greatly, the vertebral column and its appendages being cartilaginous in the genus *Scaphirhynchus*, while in *Lepidosteus* it is ossified; and the vertebræ have a posterior cup and anterior ball (opisthocœlous), a character of some Amphibians. The skull is cartilaginous in the sturgeon, bony in *Lepidosteus*. The body is naked in *Spatularia*; the skin of the sturgeon is set with bony tubercles and bony plates; the scales, which form a regular investment in the other genera, are cycloid n *Amia* and some Carboniferous genera, rhomboidal in *Polypterus* and *Lepidosteus*, and most fossil genera. They are of bone, the outer layer of which is dense, and its smooth polished surface gives it a resemblance to enamel. The following is a summary of the classification of the order and of the distribution of its genera:—

Sub-order 1: *Chondrosteid Ganoids*. The Sturgeon (*Acipenser*) is found in the rivers of the northern hemisphere, often in their estuaries, but sometimes descending to the sea. The naked-bodied *Spatularia* and *Scaphirhynchus* belong to the northern rivers of America. The Liassic genus *Chondrosteus* is the earliest member of the group.—Sub-order 2: *Cephalaspidæ*. The *Pteraspis* and *Cephalaspis* of the Upper Silurian and Lower Old Red Sandstone strata had the head covered with a bony shield, which in form somewhat resembled the carapace of some Crustaceans; the body of *Cephalaspis* had bony scales.—Sub-order 3: *Placodermi*. The Berry-Bone (*Coccosteus*), the Seraphim (*Pterichthys*), and the *Asterolepis* also had a bony shield, the flexible trunk having scales in *Pterichthys*, being naked in *Coccosteus*. The anterior limbs, or pectoral fins, of *Pterichthys* were long, covered with closely-fitted plates, and had a complex joint connecting them with the thorax. These fishes, which some regard as probably osseous, belong to the Old Red Sandstone and Carboniferous formations.—Sub-order 4: *Lepidosteidæ*. The Garpikes, or Bony-pikes of the American lake region, are the modern representatives of the *Lepidotus*, *Æchmodus*, &c., of Mesozoic strata, and of the Carboniferous *Palæoniscus*, while the Old Red Sandstone genus *Cheirolepis* is by some referred to this group.—Sub-order 5: *Crossopterygidæ*. *Polypterus*, the type of this group, is confined to the Nile and a few other African rivers. The group is most abundant in the Palæozoic strata, *Dipterus*, *Osteolepis*, *Holoptychius*, *Phaneropleuron*, being Old Red Sandstone genera; *Rhizodus*, *Megalichthys* with rhomboidal scales, *Strepsodus* with cycloid scales, Carboniferous. The Cœlacanths range from the Carboniferous to the Chalk formations, and are the only members of the order in which the extremity of the vertebral column divides the tail equally (*homocercal*).—Sub-order 6: *Amiadæ*. The Mud-fishes of the Missouri have only doubtful fossil representatives.—Sub-order 7: *Acanthodidæ*. Fine shagreen-like scales and spines in front of some of the fins give this group a curious resemblance to the sharks; but though the skeleton is cartilaginous the terminal mouth and five teeth are ganoid characters. The *Acanthodidæ* are Old Red Sandstone and Carboniferous forms.—Sub-order 8: *Pycnodontidæ*. The resemblance between these fishes, with deep bodies much compressed from side to side, and the File-fish (*Balistes*) is striking, and some of the group may be transferred to that family of osseous fishes, while others perhaps belong to the Plectognath family. But the character of the scales, the spiral intestinal valve, and the partially unossified skeleton, seem to indicate some at least as true ganoids. The sub-order is represented from the Carboniferous to the Miocene formations. See ICHTHYOLOGY.

GANYMEDE, in the mythology of Greece, great-grandson of Dardanus, who founded the city of Troy, son of Tros and of Callirrhoë, a daughter of the Scamander. Zeus sent his eagle from heaven, which carried him off from Mount Ida to the seat of the gods, where he discharged the office of cup-bearer to the immortals, Hebe having rendered herself unworthy of this office. This fiction has afforded, both to poets and artists, an inexhaustible supply of subjects. Numerous paintings, statues, cameos, and intaglios, masterpieces of ancient art, have descended to us, upon which this youth, scarcely past the years of boyhood, is represented as of great beauty. The representations of Ganymede are to be recognized by the Phrygian cap and the eagle, which is either standing beside him or carrying him in its talons to Olympus.

GAOL, or JAIL, a prison or place of legal confinement. See PRISON DISCIPLINE.

GAOL DELIVERY, a commission to the judges on assize to try and deliver every prisoner in gaol on their arrival at the assize town. See ASSIZES.

GAP (ancient *Vapincum*), a town, France, department of Hautes-Alpes, in a finely-wooded valley watered by the Bonne and Luye, about 100 miles

south-east of Lyons. It was formerly capital of a district called Gapençois, was fortified, stood several sieges, and had a pop. of 16,000, but owing partly to the plague in 1632, the revocation of the edict of Nantes, and the sacking by the Duke of Savoy in 1692, its prosperity has greatly declined, and the pop. is now 7159. Among its public buildings are a fine old Gothic cathedral, a court-house, town-house, episcopal palace, theatre, and barracks. The trade is chiefly in leather, wool, fruit, corn, and cattle.

GARANCINE is prepared from the ground root of *Rubia tinctorum* or madder (in French *garance*) by washing it with eight or ten times its weight of water acidulated with sulphuric acid, 1 part of acid being used for 100 parts of powder. After digesting for seven or eight hours the fluid is run off, and the paste is boiled for two or three hours by steam with more acid, and then the mass is thrown into cold water contained in a large trough with a perforated bottom covered with cloth to act as a filter. Here it is washed till all the acid is got rid of, and the paste is afterwards pressed, dried, and ground to fine powder. Garancine has a dark brown colour, and is only partially soluble in water, both cold and hot. In hard water it is less soluble than in soft. It is dissolved to some extent by acids, the solution being yellow. It is taken up very readily by alkalies, which acquire a dark red or claret colour. With alum it gives a reddish lake. By gentle heating it yields fine orange needles of alizarine. It is used for dyeing, and has the advantage over madder of containing a large proportion of colouring matter, so that 1 part of garancine is estimated as equal in tinctorial power to from 3 to 5 of madder. On the other hand, the dye is less solid and brilliant, and some tints cannot be so well obtained as with the root itself. This is due probably to the action of the sulphuric acid, which liberates other colouring matters from the root which do not take part in ordinary madder dyeing. It is preferable, however, to madder for mixing with other dyestuffs to produce chocolate and some other shades. (See MADDER.) The substance called *garanceux* is the exhausted madder from the dyeing vats, treated with sulphuric acid, and washed thoroughly. It consists mainly of purpurine, the alizarine having been removed, and is employed for dark colours.

GARAY, JÁNOS, a Hungarian poet, born at Szegszard in 1812; died blind in 1853. He studied at Fünfkirchen and Pesth, and held a minor post in the public library of the latter place. His taste being formed by a thorough study of German masterpieces, and his genius being roused by the powerful poems of Vörösmarty, he published in 1834 his heroic poem of Csatár, which was full of promise for the future. He then published in rapid succession a number of dramas, mostly based on historical events, among which may be mentioned Arbocz (1837), Országy Ilona (1837), and Bátory Erzsébet (1840). In 1834–36, while co-editor of the Regélö, and in 1838–39 editor of the Presburg Hirnök, he contributed to almost all the Hungarian periodicals and collections lyrical poems, narratives, and ballads, many of which are among the pearls of Hungarian literature. Of ballad poetry he was especially a master, as is proved by his cycle of historic ballads published in 1847, under the title Arpádok. His ballads are said to bear traces of Uhland's influence. His lyric poems, Balatoni Kagylok (Shells from Lake Balaton, 1843), are also of distinguished excellence. His last work was a historical epic (Szent László, 1850), the hero of which is St. Ladislaus.

GARBLER. Under some old statutes the garbling or sifting and cleaning of various kinds of merchandise, particularly drugs and spices, was provided for. An officer of the city of London, called the *garbler of spices*, had power to enter any shop, warehouse, &c., to examine drugs and spices, and garble or make clean the same, or see that it be done.

GARCILASO DE LA VEGA (properly *Garcias Laso de la Vega*), called the *prince of Spanish poets*, was born at Toledo in 1500 or 1503. His father was *comendador mayor* of Leon, of the order of Santiago, counsellor of state in the reign of Ferdinand the Catholic, and ambassador at the court of Leo X.; his mother was Donna Sancha Guzman. Both families are very ancient. According to an account given in the Historia de las Guerras Civiles, the Garcilasos received their surname from their combats with Moorish heroes, in the great valley of Granada, called *La Vega*. Gifted by nature with all the qualities of a poet, Garcilaso soon found his proper sphere. His genius was kindled by the study of the ancients, particularly of the Romans. Boscan had already begun to transplant the versification of the Italians into Spanish poetry. Garcilaso followed his example, and, destroying his earlier attempts, imitated the Italians only. He succeeded so well that he is still ranked among the best Spanish poets. Most of the events of his life may be learned from his own works. He lived for a long time in Italy, and afterwards travelled through part of Germany, in the service of Charles V. In 1529 he was engaged in the expedition against Soliman, and in 1535 in that against Tunis. In the latter he received a wound in his arm, after which he remained some time in Naples. In 1536 he commanded thirty companies of infantry, and accompanied the imperial army against Marseilles. Upon its retreat the army was detained by a tower garrisoned by Moors, said to be the tower of Muy, near Fréjus. The emperor gave him orders to take it. Garcilaso, amidst a shower of stones, pressed forward with a halberd in his hand; but scarcely had he placed his foot upon the ladder when he fell to the ground, dangerously wounded in his head. He was carried to Nice, where he died at the age of thirty-three years. His body was brought to Toledo in 1538 and placed in the tomb of his family. When we consider his early death and his active and troubled life, we are astonished at the perfection of his poems. Spanish poetry is highly indebted to him; for without his aid Boscan, a foreigner, would never have succeeded in his innovations, more particularly as he had a formidable adversary in Christoval de Castillejo. Boscan was so grateful for the assistance that he collected the works of his friend with the greatest care. They consist of eclogues, epistles, odes, songs, sonnets (in which he imitated Petrarca), and some smaller poems. An edition of his works, with notes, appeared at Madrid in 1765, and Herrera's commentary (Seville, 1580), with notes by Azara (Madrid, 1765, 4to).

GARCILASO (GARCIAS LASO) DE LA VEGA, historian of Peru, surnamed the Inca, was the son of Garcilaso de la Vega, one of the conquerors of Peru, and Elizabeth Palla, a princess of the race of the incas. He was born at Cuzco, in Peru, in 1530 or 1540, went to Spain in 1560, and died at Valladolid or Cordova in 1568, 1616, or 1620. His mother taught him the Peruvian language, and is said to have inspired him with the idea of writing the history of his ancestors. The same authorities say he travelled through Peru to collect information for his history, fell under the suspicion of the Spanish government, was sent home and interned at Valladolid, where he died a few years afterwards of grief and privation. Others say he had no advantage for his work over other historians except a knowledge of the Peruvian language, which enabled him to detect mistranslations by Spanish authorities. His great work on the history of Peru is in two parts: the first

bearing the title of Historia de las Antiquedades y Conquista de Piru; Primera Parte de los Comentarios Reales que tratan del Origen de los Incas, &c. (Lisbon, 1609); the second being the Historia general del Peru (Cordova, 1616). He wrote also Historia de la Florida (Lisbon, 1609).

GARD, a department of France, in ancient Languedoc, bounded N. by Ardèche, E. by Vaucluse and Bouches du Rhone, S. by the Gulf of Lyons, S.W. and W. by Hérault, W. by Aveyron, N.W. by Lozère; area, 2253 square miles. The surface in the north is covered by the chain, and in the west by ramifications of the Cevennes; but in the south it first flattens down into a fertile plain, and then on approaching the coast becomes so low as to form extensive swamps and salines. The drainage belongs partly to the basin of the Garonne, but much more to that of the Rhone, which forms the boundary on the east. Within the department the chief rivers are the Gard and Cèze. The sides of the Cevennes are clothed with chestnut-trees, which furnish the lower classes with a considerable part of their subsistence; the lower slopes are planted with vines, which produce some wines of high name; in the more sheltered spots the olive thrives well and yields a much-esteemed oil, and in many districts the mulberry (for silk-worms), medicinal plants, madder and other dye-plants, are extensively cultivated. Of regular crops perhaps the most important is the potato; the grain raised falls far short of the consumption. Large quantities of salt are manufactured from the salines; the minerals include lead, iron, coal, gypsum, fuller's-earth, and potter's and porcelain clay. Lead, coal, and iron are worked; gypsum, building-stone, potter's-clay and kaolin are extracted. There are silk, woollen, and cotton manufactures, and among other important industries are tanning, dyeing, pottery-making, and iron-founding. Among the principal articles of trade are wine, brandy, and salt. The department comprises the four arrondissements of Alais, Nîmes, Uzès, and Vigan. Nîmes is the capital. Pop. in 1896, 413,841; in 1901, 418,470.

GARD, Pont du, a Roman aqueduct, in above dep., 10 miles from Nîmes, joining two hills and passing over the Gard. It consists of three tiers of arches; is 157 feet high, 530 long at the bottom, and 872 at the top. The grandeur and simplicity of this structure, still wonderfully well preserved, excite the admiration of every traveller.

GARDA, or Benaco, Lake (Ital. *Lago di Garda*; the *Benacus Lacus* of the Romans), an extensive and beautiful lake in north Italy, 33 miles long from north to south, by 3 to 11 miles broad, 213 feet above sea-level; bounded E. by the province of Verona, S. by Mantua, and W. by Brescia, while its north extremity enters the Austrian territory of Trent, in the Tyrol. It receives the Sarca, almost its only affluent, at its north end, and is drained by the Mincio, which issues from its south-east end, near the fortress of Peschiera, and conveys its waters to the Po. Storms are not infrequent, and are sometimes violent. It is well stocked with excellent fish, including salmon-trout, trout, eels, and pike. Garda is the largest lake in Italy, and attains a depth of over 1000 feet in many places. Steamboats ply on it regularly between the ports of Riva and Desenzano, and between Riva and Peschiera, and its shores are covered with villas.

GARDAIA, or Ghardeia, a town of Algeria, in the oasis of Wady Mzab, in the Sahara. It is surrounded by a battlemented wall, flanked with towers, and consists of well-built and whitewashed houses. Walls divide the town into three parts, the centre occupied by the Mzabi, the eastern by Jews, and the western by Arabs. Among its public edifices are mosques and a Jewish synagogue. A considerable trade is carried on, chiefly in oil, corn, butter, pottery, &c. The environs are covered with vineyards and gardens, supplied with water by deep wells. There is a French fort and garrison here. Pop. (1901), 9315.

GARDE ÉCOSSAISE, the Scotch guard in the service of the kings of France, created by Charles VII. in 1445. It is said that Louis IX. formed a guard of twenty-four Scots to accompany him on his crusade. During the Hundred Years' War between England and France, numerous bodies of allies were sent from Scotland to France, and many Scotchmen were incorporated in the French armies. It was in recognition of their services that Charles VII. instituted the Scottish company on a regular footing. In 1453 he selected a hundred archers to form a special body-guard. There was also another company of a hundred Scots placed at the head of a regular force of fifteen companies of 100 lances each, which was organized. Each lancer in these companies had six persons as his attendants, a man-at-arms, a page, three archers, and a *coutelier*, all on horseback. This body was commanded by Scotchmen of the highest rank. James VI., at the request of his mother, was made its captain in 1584. His son Henry received the same appointment, and on his death was succeeded by his brother, afterwards Charles I. James II., when Duke of York, also held the captaincy. Louis XIV. gave the Scotch guard the precedence of all other military bodies, even on some occasions of the musketeers of the guard.

GARDELEGEN, a town of Prussia, in the province of Saxony, 30 miles N.N.W. Magdeburg, on the Milde. It is surrounded by an old wall with three gates, and has manufactures of beer, buttons, cotton, linen, &c. Pop. (1895), 7630.

GARDE NATIONALE, a guard of armed citizens instituted at Paris, July 13, 1789, for the purpose of preserving order and protecting liberty. At first it numbered 48,000 men, and was composed indiscriminately of citizens of all grades, including even priests. The guard did not take much part in the capture of the Bastille, but its institution paralysed the court and contributed to the popular victory. On the morning after the capture of the Bastille the assembly of the electors chose La Fayette by acclamation commander of the guard. On his proposition it definitely assumed the title of National Guard, and similar bodies were organized in all the towns of the kingdom, the force speedily amounting to 300,000. The Parisian uniform of red and blue was adopted, and the Parisian cockade, which, by the addition of the royal white, La Fayette converted into the tricolour. The national guard of Paris was, in accordance with this scheme, organized as a regular army with infantry, cavalry, and artillery, and with all the subordinate branches of the service. On 14th October, 1791, the National Assembly organized by a definite law the national guard of France. It decreed that the guard being the organization of the force of the people for the interior service of the country, it should have one law, one discipline, and one uniform. The national guard, especially in Paris, early became a force in the revolution. From its constitution, embracing all the various shades of popular opinion, it naturally tended to form within itself two distinct parties, a progressive one, generally the majority, and a conservative or reactionary one. After the 9th Thermidor (27th July, 1794) it was reorganized by the exclusion of the more revolutionary party, and it subsequently acted as a royalist and reactionary force on the 13th Vendémiare (5th October, 1795), when it was crushed by Napoleon. It

was reorganized by the Directory, and finally by Napoleon, and in his hands it became merely an additional instrument of the executive government. The national guard of Paris was reconstituted in 1814 on a Napoleonic model, and assisted in the defence of Paris. Under the Bourbons the guard, though reconstructed and put under the command of the Duc d'Artois as colonel-general of all the garde nationale of France, was a subject of constant disquietude, and it was dissolved by a royal ordinance in 1827. Under Louis Philippe it was resuscitated in its old form, with the right to name its own officers, and La Fayette again became its general-in-chief. Nevertheless, it contributed to the overthrow of Louis Philippe. In 1848 it was entered by crowds of workmen, and the use of a uniform ceased to be obligatory. In the insurrection of June part of the national guard acted for, and part against the insurgents. On the suppression of the insurrection Cavaignac disarmed entire legions. In 1851 the national guard was reorganized, but in 1855 it was dissolved. In 1870 the national guard of Paris was again reorganized by the provisional government to assist in the defence of the city against the Prussians. By the capitulation of Paris it was allowed to retain its arms, from which disastrous consequences ensued. The French government under M. Thiers ordered the disarmament of the guard, part of which resisted, and thus arose the communal war. After the war the National Assembly decreed the dissolution of the national guard, and there seems to be no intention of resuscitating it.

GARDE NATIONALE MOBILE. The garde mobile was formed by Napoleon III. in 1868, on the suggestion of Marshal Niel, then minister of war. It was intended to form bases of regiments to supplement the regular army, to which it was estimated in time of war to add 550,000 men. It was called into action in the war of 1870–71, but was found too ill organized to be of efficient service. The Mobiots, as they were familiarly called, sometimes fought well, but the proprietors of the environs of Paris are said to have dreaded them more than the Prussians.

GARDENING. See HORTICULTURE.

GARDES SUISSES. Swiss companies served in France from the time of Louis XI., who paid particular attention to cultivate the friendship of the Cantons. In 1571 Charles IX. created the charge of Colonel-general of the Swiss for Montmorency, who commanded all the Swiss in the kingdom, except the 100 guards of the king. The institution of the Swiss guards as a complete regiment dates from 1616. In 1714 it was composed of twelve companies, some of which had two captains. Louis XIV. gave it five officers to each company. All the officers and men were Swiss, and the companies mounted guard before the king according to the rank of the cantons to which their captains belonged. The Swiss guards followed in order of precedence after the French guards. They enjoyed liberty of worship. According to the arrangement with the Cantons the Swiss guards could not be obliged to serve against Germany beyond the Rhine, against Italy beyond the Alps, or against Spain beyond the Pyrenees. This convention was often broken. The attachment of the Swiss guards to the king made them obnoxious to the people during the revolution. They were repeatedly banished and recalled, and on and after the 10th of August, 1792, when they had to defend the Louvre against the mob, they were massacred without mercy.

GARDINER, STEPHEN, an English prelate, distinguished for his opposition to the Reformation, as well as for learning and statesmanship, was once believed to be a natural son of Lionel, bishop of Salisbury, and brother of Elizabeth Woodville, queen of Edward IV. Born about 1483, at Bury-St.-Edmund's, of uncertain parentage, he was educated at Trinity Hall, Cambridge, and took the degree of doctor both in civil and canon law, and in 1525 became Master of Trinity Hall. Having been tutor of a son of the Duke of Norfolk, he was introduced to Wolsey, who made him his secretary. He was consulted about the king's divorce, and in 1528 he was despatched along with Dr. Edward Fox on a special mission to Rome to forward it. In 1529 he was recalled to be the king's counsel in prosecuting the divorce in England, and on his return was appointed secretary of state, and received in succession the archdeaconries of Norwich and Leicester, and in 1531 the bishopric of Winchester. He constantly opposed the doctrines of the Reformation, and stimulated the king to persecute their followers. He took an active part in the passing of the six articles, and in the prosecution of Lambert, Ann Askew, and other Protestants. It is said that he endeavoured to plot against the queen, Catherine Parr, in connection with religion, but that she proved too shrewd for him. But there is no trustworthy evidence for this, and probably it is a mere invention. During the reign of Edward VI. he was first imprisoned in the Fleet, and afterwards deprived of his bishopric, and imprisoned in the Tower from 1548–53. On the accession of Mary he was released, restored to his bishopric, and appointed lord chancellor. He took an active part in the persecutions at the beginning of this unhappy reign, but some time before his death he withdrew from the courts for the trial of heresy. He died on 12th November, 1555. He left several works: De Vera Obedientia (1535), a defence of the king's supremacy; A Necessary Doctrine of a Christian Man (1543); Sacrament of the Aulter (1551); and some tracts.

GARFIELD, JAMES ABRAM, the twentieth president of the United States, was born in a village near Cleveland in Ohio, 19th November, 1831. Early left fatherless, he soon became familiar with rough work in the fields, at the carpenter's bench, and for a short time as a canal boatman. Having saved enough of money for the purpose he entered Williams College in Massachusetts, where he graduated in 1856. He was afterwards engaged as teacher of languages, and ultimately as president of an educational institution in Ohio. He became a member of the state senate in 1859, and having applied himself to the study of law, he was called to the bar in 1860. When the civil war broke out he was appointed to the command of an Ohio regiment, and served with much distinction, receiving the rank of general for gallantry at the battle of Chickamauga. He entered Congress for the first time in 1863, where he soon took a good place, and filled several important posts. He was elected to the Senate in January, 1880, and was chosen President of the United States in the following November, entering upon office in the spring of 1881. He firmly resisted the importunities of venal intriguers and place-hunters, caring more for the uprightness and purity of his administration than for party interests. This line of conduct made him many enemies, and on 2d July of the same year he was shot in a Washington railway-station by Charles Guiteau, a broken-down attorney from Chicago. Garfield lingered on for eleven weeks, suffering much with a manly fortitude, and died 19th September, amidst the sincere grief of the whole civilized world. A life of Garfield was published by J. R. Gilmore in 1880.

GAR-FISH, SEA-PIKE, or GAR-PIKE (*Belone vulgaris*, Cuv. and Val.). This fish, which is known also under the name of *sea-needle*, makes its appearance on the English coast in summer, a short time previous

to the arrival of the mackerel, which it much resembles in taste. It is long and slender, flattened a little towards the belly, and quadrangular towards the tail. The head is flattened, projecting forward into a very long, sharp snout, the lower being longer than the upper jaw.

GARGANO (Latin, *Garganus*), a mountain group of South Italy, province of Foggia. It forms the spur of the boot in the Italian Peninsula, and consists of a central mass with radiating branches. The loftiest summit is Calvo, 5450 feet.

GARGARA (Turkish, *Kasdagh*), the highest mountain of the ridge of Ida, in Asia Minor, near the Gulf of Adramyti, on the north. The height is about 5700 feet.

GARGLE, a liquid application to the throat and gullet. In using a gargle the head should be thrown well back so as to keep the gullet open, and by expelling the air from the lungs through the liquid the passage may be thoroughly washed. Care should be taken, especially if the throat is diseased, not to swallow the gargle.

GARGOYLE, in Gothic architecture, a projecting spout for throwing the water from the gutter of a building. Being usually in some grotesque form, as the head of a monster, it always forms a striking feature of the architecture.

GARHWAL. See GURHWAL.

GARIBALDI, GIUSEPPE, the great Italian patriot and hero, was born at Nice, July 4, 1807, his father being a poor fisherman. He got little education, but managed by his own efforts to acquire a knowledge of several languages as well as of mathematics. Adopting the life of a sailor, for a number of years he made voyages in trading vessels. In 1834 he entered on his political career, becoming a member of the "Young Italy" party, and being condemned to death and driven into exile for his share in a plot elaborated by Mazzini for the emancipation of Italy. After teaching for a short time at Marseilles and next serving as an officer on board the fleet of the Bey of Tunis, he went to South America. Here he gave his services to the Republic of Rio Grande in its struggle against the Brazilians, and after making his name well known as a daring and successful leader he joined the Monte Videans, who were waging war against Rosas, the dictator of Buenos Ayres. With the famous Italian legion under his command no troops could stand against him, and in 1846 at San Antonio he kept at bay for a whole day a hostile force ten times as numerous as his own, earning the title of the "hero of Monte Video." The Monte Videans were profuse in their gratitude, but no substantial reward would Garibaldi accept, although at this time in great poverty, and having now to provide for a wife and child. In 1848 he returned to Italy, hoping to be of use to his native country in its struggle against the Austrians. He was coldly received by the Sardinian government, however, but raising a band of volunteers, latterly 1500 strong, he harassed the Austrians, and gave continual employment to 10,000 of the enemy's troops. On the cessation of hostilities, which was speedily followed by the re-establishment of Austrian supremacy in Lombardy, Garibaldi disbanded his followers and retired to Switzerland, in the spring of 1849 proceeding to Rome to give his support to the short-lived republic established by Mazzini. (See ITALY.) By this time his fame had spread over the whole of Italy; and as Camicia Rossa (Red Shirt) he was the hero of the "Young Italy" party. Receiving chief command of the republican forces he soon had fighting to his heart's content. But all his valour and military skill were insufficient to maintain the cause of the republic against the overpowering forces brought against it, and after a desperate defence of thirty days Garibaldi escaped from Rome with 4000 of his followers. Soon he had to disband his men and make for a place of safety. In the course of his flight his wife Anita, for ten years his associate in all adventures, died from fatigue and privations. Getting on board a coasting vessel he reached Genoa, and shortly after went to the United States. He now engaged in commercial pursuits, being for some years in command of a merchant vessel, and having succeeded in saving a little money he purchased a part of the small island of Caprera, off the north coast of Sardinia, and made this his home for the rest of his life. Latterly the subscriptions of his admirers enabled him to become owner of the whole island, and by his industry and skill in farming he greatly improved its productiveness. Meanwhile his dream of a free and united Italy was drawing towards fulfilment—a result due to the statesmanship of Cavour and the patriotism of Victor Emmanuel. In the war of 1859, in which Sardinia, assisted by France, recovered Lombardy from the Austrians, Garibaldi and his glorious band of Chasseurs of the Alps did splendid service in their country's cause and inflicted disastrous defeats on the enemy. He and Victor Emmanuel met for the first time at Milan, now emancipated, and the king with his own hands fastened on the breast of the general the gold medal for military bravery. The termination of the war without the emancipation of Venetia was a bitter disappointment to all Italian patriots, and to Garibaldi the cession to France of Savoy and Nice was a still more severe blow. Early in 1860 the Sicilians rose in revolt against Bourbon tyranny, roused by the events that had taken place in Northern Italy, the duchies and a large part of the pope's dominions having by this time transferred themselves to the rule of Victor Emmanuel. To aid this movement Garibaldi with 1000 men set sail from Genoa and landed at Marsala in Sicily (May 12), the people with one voice welcoming him as a deliverer. In less than two months he was master of the whole island except Messina, and on 21st July it too fell into his hands after a sanguinary battle. Crossing over to the mainland he was received with similar enthusiasm, and meeting with little real resistance he entered Naples on 7th September. There he was proclaimed Dictator of the Two Sicilies. It was now feared that Garibaldi might prove untrue to the motto on his banner—Italy and Victor Emmanuel—but personal ambition was far from his thoughts; he readily acquiesced in the annexation of the Two Sicilies to his sovereign's other dominions, and declining all honours and rewards he retired to his island farm like Cincinnatus of old, as poor as when he had left it six months before. This was the culminating point in Garibaldi's career. He was the idol of the Italian nation, the ideal hero and patriot of the civilized world; and it would have been well perhaps had he now retired altogether from public life. For on the death of Cavour in 1861 he fell more and more under the influence of the extreme party, and some of the affairs in which he, after this time, was the chief spirit were ill advised. In 1862 he endeavoured to force the Roman question to a solution. With a small number of men he went to Sicily and thence to Calabria. But the Italian government could not then afford to break with France, whose troops were in Rome; and Garibaldi was taken prisoner at Aspromonte, on the defeat of his followers by the royal troops. He was soon released, however, and returned to Caprera. In 1864 he visited Britain, his visit giving rise to unbounded enthusiasm. In 1866 he commanded a volunteer force against the Austrians in the Italian Tyrol, but failed to accomplish anything of consequence. Next year he at-

tempted the liberation of Rome, but near Mentana he was defeated by the French and pontifical troops. He was again imprisoned by the Italian government, but was soon pardoned and released. In 1870 he gave his services to the French republican government against the Germans, and with his 20,000 men rendered valuable assistance in the south-east. At the end of the war he was elected a member of the French assembly but speedily resigned his seat and returned to Caprera. Rome now became the capital of united Italy, and here in January, 1875, Garibaldi took his seat in the Italian parliament. The latter part of his life was spent quietly at Caprera. After 1870 he wrote two or three novels—very mediocre productions. He died somewhat suddenly June 2, 1882. As all his actions showed, Garibaldi was a patriot actuated entirely by love for his country, and ready to sacrifice himself at any time for its good, without a thought of advantage to himself. Riches, titles, and conventional distinctions he cared not for. He gloried in undertaking enterprises that to most men would have seemed rash or hopeless. His autobiography was published in 1887, and translated into English with a supplementary biography in 1889.

GARIEP. See ORANGE RIVER.

GARIGLIANO, a river, Italy, formed by the junction of the Liri and Sacco near Pontecorvo. It flows south-east and south-west, and after a course of 40 miles falls into the Gulf of Gaëta.

GARLIC (*Allium sativum*) is a species of onion cultivated in Europe since the year 1551. The leaves are grass-like, and differ from those of the common onion in not being fistulous. The stem is about 2 feet high, terminated by a head composed principally of bulbs instead of flowers; the flowers are white; the root is a compound bulb, consisting of several smaller bulbs, commonly denominated *cloves*, enveloped by a common membrane. Garlic has a strong, penetrating odour, and a pungent acrid taste. It differs from the onion only by being more powerful in its effects. In warm climates, where garlic is considerably less acrid than in cold ones, it is much used both as a seasoning and as food. When bruised and applied to the skin it causes inflammation and raises blisters. In the south of Europe, particularly in Spain, it enters into the composition of almost every dish, not only among the common people, but among the higher classes of society. At all times, however, while it has been prized by some nations it has been detested by others, as by the ancient Greeks. Its cultivation is easy, being a hardy plant, growing in almost every kind of soil; and it is reproduced by planting the radical or floral bulbs. Its medicinal virtues have also been much celebrated. The juice of garlic is a strong cement for broken glass and china. Snails, worms, and the grubs or larvæ of insects, as well as moles and other vermin, may all be driven away by placing preparations of garlic in or near their haunts. The virtues of garlic are most perfectly and readily extracted from the bulbs by spirit of wine.

GARLIC, OIL OF. When the sliced bulbs of garlic are distilled with water an oil with a yellow colour, strong smell, and burning taste comes over. This consists chiefly of sulphide of allyl $(C_3H_5)_2S$ mixed with some allylic oxide. The latter is got rid of by decomposition with potassium, and then on rectifying the pure sulphide is obtained. It boils at about 300°, is colourless, smells strongly of garlic, is lighter than water, insoluble in that fluid, but dissolves readily in alcohol and ether; is not acted on by dilute acids or alkalies, but is attacked by strong nitric acid; and it forms double compounds with salts of silver, mercury, palladium, and other metals. Oil of garlic acts as a powerful irritant when applied to the skin. The sulphide of allyl is contained in other plants—asafœtida, the leek, onion, &c.

GARNET, a beautiful mineral, or group of minerals, crystallizing most commonly in the form of a regular dodecahedron. It sometimes occurs in fragments or grains, and in amorphous masses, either lamellar or granular. Its varieties are not all equally hard. They, however, strike fire with steel, and scratch quartz. Its fracture is uneven, or more or less conchoidal, and its lustre, though variable in degree, is usually vitreous, sometimes resinous. Its specific gravity extends from 3·15 to 4·35. Its prevailing colour is red of various shades, but it is often brown, and sometimes green, yellow, and black. It is usually translucent, sometimes transparent, and not seldom opaque. It is easily melted by the blowpipe into a dull, black enamel, which is often magnetic. A very large number of garnets have been analysed and described, and they are generally arranged in six classes. The first of these is the *Lime Garnet*, containing five varieties:—*Grossularite* is of a gooseberry-green colour, and crystallizes in the ordinary forms of the species; it occurs in Siberia. *Essonite*, or *cinnamon-stone*, is of a colour varying from hyacinth-red to orange-yellow. It is both crystallized and in grains. Besides these there are others called *romanzovite*, *succinite*, and *topazolite*.—Second. *Magnesia Garnet*. It is of deep coal-black colour.—Third. *Iron Garnet* includes two or three varieties:—*Precious garnet*, or *almandine*, is red, with shades of violet, purple, and blue, and its crystals are found imbedded in various forms. Fine specimens are found in Ceylon, Pegu, Brazil, Bohemia, and Transylvania. It is translucent and often transparent, but frequently impure at the centre. This variety is found both in primitive and secondary rocks, and sometimes in alluvial earths. The term *oriental*, sometimes applied to this variety, indicates not a locality, but merely a great degree of perfection. Similarly the term *noble* refers to its beauty and value. The precious garnet, and the species called *pyrope*, are employed in jewelry for brooches, ring-stones, necklaces, &c. When cut *en cabochon* it forms the carbuncle, and there is no doubt the *carbunculus* of the ancients was a garnet. According to Pliny it was sometimes formed into vessels capable of containing nearly a pint. In the National Museum at Paris is a head of Louis XIII. engraved on a garnet. *Common garnet* seldom occurs in red colours, and these are of dirty shades. Its crystals are generally implanted. It is abundantly met with in the crystalline rocks. When the particles of garnet become impalpable the variety called *allochroite* is formed. It is dingy yellow, and is got only in Norway.—Fourth. *Manganese Garnet* has a brownish-red colour.—Fifth. *Iron-lime Garnet*, green, yellow, reddish-brown, and black, contains a great number of varieties:—*Aplome* is of a brown, orange, or greenish colour, crystallized in dodecahedra, with the acute solid angles truncated. *Colophonite* is a compound variety of yellowish-brown and reddish-brown or honey-yellow colours, consisting of roundish particles so aggregated as to be easily separated. *Melanite* is of a perfectly black colour, and generally crystallized in dodecahedra, with their edges truncated. *Pyreneite* occurs in small blackish crystals, imbedded in a dark-coloured limestone, and hitherto found in the French Pyrenees.—Sixth. *Chrome Garnet* includes *ouvarowite*, of an emerald-green colour, which is found in the Ural Mountains; and *pyrope*, which occurs only in grains, and is characterized by its pure translucency and blood-red colour. It is found in Bohemia and some other countries in alluvial deposits, accompanied by hyacinths and sapphires. The following table will show the composition of garnet in its principal varieties:—

	Grossular	Melanite.	Precious Garnet.	Colophonite.	Pyrope.	Essonite.
Silica	44·00	35·50	40·56	37·00	41·35	36·55
Alumina	8·50	6·00	20·61	13·50	22·35	18·75
Lime	33·50	32·50	..	29·00	5·29	31·44
Protoxide of Iron	..	..	32·70	1·00	..	..
Oxide of Manganese	..	·40	1·47	4·75	2·59	1·70
Oxide of Chromium	..	..	..	..	4·17	..
Magnesia	..	..	..	..	15·00	4·20
Peroxide of Iron	12·00	24·25	5·00	7·50	9·94	6·61

The common garnet may be advantageously employed as a flux for iron ores. The powder of the garnet is used in polishing hard bodies, and is sometimes called *red emery*.

GARNISHMENT. See ATTACHMENT (FOREIGN).

GAROFALO, BENVENUTO (properly *Benvenuto Tisi da Garofalo*), a historical painter, born at Ferrara in 1481. In this city and in Cremona he cultivated his talents for painting; but the master-pieces of art in Rome exercised the greatest influence upon him. In the year 1505 he is said to have returned to Rome, and to have formed a very close intimacy with Raphael, who often made use of his assistance. He afterwards painted for Alfonso I., in his native city, where he died in 1559; he had been blind for several years. Garofalo's works show the influence of all the schools, particularly of the Lombard, and still more so of Raphael's, whom he surpassed in colouring. Most of his works are at Rome. Several of them, however, are in the galleries of Vienna and Dresden.

GARO HILLS, a district of India, forming the south-western corner of Assam; area, 3146 square miles. It is a mountainous region, rising in some points to 4500 feet, and forms a water-shed in which rise several tributaries of the Brahmaputra. The Garos are a robust and active race. Pop. 121,570.

GARONNE (Latin, *Garumna*), a river of France, formed of two head streams, of which its name is said to be compounded, rising in the vale of Aran, in the Spanish Pyrenees. It enters France and flows, exclusive of deviations, north-west to the Atlantic, through the departments of Haute-Garonne, Tarn-et-Garonne, Lot-et-Garonne, and Gironde. Below Toulouse it receives, on the left, the Save, Ratz, Gers, Baise, and other affluents; on the right, the Tarn, the Lot, and the Dordogne, on joining which, about 12 miles below Bordeaux, it changes its name to the Gironde. It is navigable on the descent from St. Martory, and both ways from Toulouse. At Toulouse the Canal du Midi unites it with the Mediterranean at Narbonne, forming a communication between the Mediterranean and the Atlantic; and the Canal Latéral, from Toulouse to Castets-en-Dorthe (Gironde), supplements its direct navigation, which is difficult.

GARRICK, DAVID, the most eminent actor ever produced by the English stage, was born at Hereford in 1717. His grandfather was a French refugee, his father a captain in the army. He was educated at the grammar-school of Lichfield, but was more distinguished for his sprightliness than attachment to literature; and he gave an early proof of his dramatic tendency by inducing his school-fellows to act the Recruiting Officer, in which he himself took the part of Sergeant Kite, being then only twelve years of age. As the circumstances of his father were narrow, he was sent to Lisbon upon the invitation of his uncle, a wine merchant in that capital, in order that he might learn the wine trade. His stay at Lisbon was short; and returning to Lichfield, he was placed, along with a brother, under Samuel (Dr.) Johnson. In 1737 Garrick and his grave tutor travelled in company to the metropolis, and Garrick was placed under the care of a mathematician for several months, with a view of cultivating his general powers previously to his admission as a student of law. The death of his father, however, disturbed this arrangement; and having been left a legacy of £1000 by his uncle, he joined his brother, Peter Garrick, in the wine trade. This connection was soon dissolved, and in 1741 he gave way to his inclination by joining Giffard's company at Ipswich, where, under the name of Lyddal, he played a great variety of parts with uniform success. At this time the stages of the metropolis were but indifferently supplied with leading performers, so that when Giffard, who was manager of a theatre in Goodman's-fields, introduced his accomplished recruit there, Oct. 19, 1741, the effect was immediate and decisive. He judiciously chose the part of Richard III., which did not require that dignity of person in which he was deficient, while it gave him scope for all the strong marking of character and changes of passion in which his principal excellence consisted. He at the same time adopted a natural mode of recitation, which was a daring innovation on the part of a new performer, before audiences accustomed to the artificial declamation of the school which preceded him. The part of Richard was repeated for many successive nights, and the established theatres were deserted. In May, 1742, he played three nights at Drury Lane; afterwards visited Dublin, where his success was even greater than in the metropolis, and on his return commenced an engagement at Drury Lane (5th October). In 1745 he became joint manager with Sheridan of a theatre in Dublin. In 1746 he was engaged for the season at Covent Garden, and at its close he purchased Drury Lane in conjunction with Mr. Lacy, and opened it 15th September, 1747, with the Merchant of Venice, to which Dr. Johnson wrote a prologue for the occasion. This period formed an era in the English stage, from which may be dated a comparative revival of Shakspeare, and a reform both in the conduct and license of the drama. In 1749 he married Eva Marie Violetti (1724–1822), and his married life seems to have been happy.

The remainder of his theatrical career was a long and uninterrupted series of success and prosperity until its close. Although careful of money, and occasionally testy in his intercourse with authors, he managed to keep on terms with the majority of the most respectable, and received from many of them an excess of incense, which was but too acceptable. In 1763 he visited the Continent, and on his return, after an absence of a year and a half, was received with unbounded applause. He had written, while an actor, his farces of The Lying Valet, Lethe, and Miss in her Teens; and in 1766 he composed, jointly with Colman, the excellent comedy of The Clandestine Marriage. The year 1769 was signalized by the famous Stratford jubilee—a striking proof of his enthusiasm for Shakspeare. It occupied three days at Stratford, and its representation at the theatre lasted for ninety-two nights. After the death of Lacy, in 1773, the sole management of the theatre devolved upon Garrick, who continued to fulfil the duties of that office until 1776, when he determined upon his final retreat, and sold his moiety of the theatre for £37,000. The last part which he performed was Don Felix in The Wonder, for the benefit of the theatrical fund. At the conclusion of the play he addressed a brief farewell to the audience. The general feeling with which this was delivered and received rendered it truly impressive; and few persons ever quitted the stage with plaudits so loud and unanimous. He died January 20, 1779. His remains were interred with great pomp in Westminster Abbey, his funeral being

attended by a numerous assemblage of rank and talent. His estate, at his death, was valued at £140,000. As an actor Garrick has rarely been equalled for truth, nature, and variety and facility of expression, for which his countenance appears to have been admirably adapted. Expression and the language of passion formed his great strength, as he was equalled by many of his contemporaries in the enunciation of calm, sentimental, and poetical declamation. His literary talents were respectable, but not eminent; besides the pieces already mentioned he wrote some epigrams, a great number of prologues and epilogues, and a few dramatic interludes, and made many and sometimes judicious alterations of old plays. A collection of his works, in three vols. 12mo, was published in London (1768 and 1798). According to Lowndes' Bibliographer's Manual it is 'a wretched and imperfect collection'. Garrick's correspondence with the most eminent men of his time was published in London, 1831–32. See Life by Joseph Knight (1894).

GARRISON, a body of troops stationed in a fortified place (fort, town, or castle) in order to defend it. The place where troops are stationed is also called a garrison.

GARROT (*Clangula*), a genus of ducks, of which one species, the *Clangula vulgaris*, or golden-eye duck, is a regular winter visitor in England, Ireland, and Scotland, especially the females and young birds of a year, which are more common than the older males. They are sometimes found in inland waters, but chiefly in the estuaries of rivers which fall into the sea. They live chiefly on small fish, and dive and swim with great rapidity. When several of these birds are together they dive alternately, the others acting as sentinels. In spring they leave this country for more northern climates, where they breed. They are numerous in Lapland, and breed in small numbers on the coast of Norway. They lay their eggs in holes of trees, and the Lapps place boxes on the trees and on the banks of rivers and lakes, in order to secure their eggs. They appear only to migrate when the rivers or lakes they frequent are frozen up. They are said by a solitary eye-witness to carry their young from their nests in the trees, which are 12 or 15 feet high, to the water in their bills, supporting them with the neck. The golden-eye also frequents the Faroe Islands, Iceland, and Greenland, and in winter Holland, Germany, the coast of France, and even Italy. It is also found in America. The general colour of the golden-eye is white beneath, with head and sides of neck rich green; back and tail bluish or grayish black, and the bill bluish-black. It has a round white spot before each eye, and two white bands on the wing; the female is ashy, with rufous head. The length of the male is about 19 inches. The form of the trachea is peculiar, being very large in the middle and again towards its divarication. The harlequin garrot (*Clangula histrionica*) is also a winter visitant in Great Britain.

GARROTE, a mode of punishment in Spain by strangulation, the victim being placed on a stool with a post or stake (Spanish, *garrote*) behind, to which is affixed an iron collar with a screw; this collar is made to clasp the neck of the criminal, and drawn tighter by means of the screw till life becomes extinct. This word, with the spelling *garrotte*, has of late years become naturalized in Great Britain as a term for a species of robbery effected by suddenly springing upon and throttling the victim, and stripping him of his property after having thus rendered him insensible.

GARTER, Order of the, the highest and most ancient order of knighthood in England. Two stories are told of its origin. The first is that Richard I. at the siege of Acre caused some of his officers to tie leather thongs round their legs as a distinction. The origin of the order is, however, generally attributed to Edward III., and the legend by which its peculiar emblem and motto are accounted for is, that the Countess of Salisbury having dropped her garter while dancing, the king restored it—some say in consequence of the queen's exhibitions of jealousy, after putting it round his own leg—with the words of the motto, '*Honi soit qui mal y pense*'—Shame be to him who thinks evil of it (that is, of the incident). The date of the foundation or restoration by Edward III. of the order is not exactly determined. 1344 is given by Froissart, while other authorities, founding on the statutes of the order, assign it to 1350. In the former year it appears that a festival was held, and a society or company instituted, called the Company of Saint George, with the design of furnishing soldiers of fortune to assist King Edward in asserting his claim to the crown of France, but it seems probable that the organization of the order as an order of chivalry was completed in 1350. The statutes of the order have been repeatedly revised. The principal revisions appear to have been made in the reigns of Henry V., Henry VIII., Edward VI., and George III.—the last in 1805. Ladies are said to have been admitted up till the reign of Edward IV. Edward VI. made the order Protestant, but his emendations were not afterwards adhered to.

The order is said to have been founded in honour of the Holy Trinity, the Virgin Mary, St. Edward the Confessor, and St. George of Cappadocia. The last is the special patron of the order. Until the reign of Edward VI. the common title of the order was the Order of St. George, and it still bears this title, as well as that of the Garter. The original number of knights was twenty-six, including the sovereign, who was its permanent head; and this number is still retained, except that by a statute passed in 1786 princes of the blood are admitted as supernumerary members. The order is frequently conferred on foreign sovereigns. It is said to be the most ancient lay order of chivalry in Europe, and no one can count more distinguished names on the roll of its membership. The vestures and insignia of the order are: the emblem of the order, the garter, a dark-blue ribbon edged with gold, bearing the motto, and with a buckle and pendant of gold richly chased. It is worn on the left leg below the knee. The mantle of blue velvet (it was changed to purple by Queen Elizabeth, and the original colour restored by Charles I.): the length of the train distinguishes the king from the other knights. The surcoat and hood of crimson velvet, the hat of black velvet, with plume of white ostrich feathers, having in the centre a tuft of black heron's feathers, and fastened to the hat with a band of diamonds. The collar of gold consisting of twenty-six pieces, each in the form of a garter, with the badge of the order, called the George, pendent from it. This consists of a figure of St. George on horseback fighting the dragon. The lesser George is worn on a broad blue ribbon over the left shoulder. The star, formerly only a cross, is of silver, and consists of eight points, with the cross of St. George in the centre, encircled by the garter. A star is worn by the knights on the left side when not in the dress of the order. The officers of the order are the prelate, the Bishop of Winchester; the chancellor, the Bishop of Oxford; the registrar, Dean of Windsor; the garter king-of-arms, and the usher of the black rod. There are a dean and twelve canons, and each knight has a knight-pensioner. On the election of a new knight the garter king-at-arms presents the Garter to the sovereign upon a velvet

cushion, from whom two of the senior members receive it, and buckle it upon the left leg of the new knight. The sovereign himself puts a ribbon with the George about the neck of the knight kneeling before him.

GARTER KING OF ARMS, the head of the heraldic establishment in England, consisting of three kings of arms—Garter, Clarencieux, and Norroy, and the herald of the military order of the Garter. The office of garter king of arms was instituted by Henry V. in 1417. The duties of the garter king of arms are principally to grant heraldic supporters, to arrange funerals, and to present the order of the Garter to foreign princes. New grants of arms in England are first signed by the garter king of arms, and afterwards by the king of the province to which the person belongs to whom the grant is made. The garter king of arms grants arms under the authority of the earl-marshal.

GARTH, Sir Samuel, English physician and poet, was born in the West Riding of Yorkshire in 1661. He received his university education at St Peter's College, Cambridge, where he graduated M.A. in 1684 and M.D. in 1691. He was admitted a fellow of the College of Physicians in the year 1693, and soon attained the first rank in his profession. A division which arose among the medical profession on the establishment of a dispensary for the poor of the metropolis induced Dr. Garth, who espoused the measure, to compose his mock-heroic poem, The Dispensary. It was published in 1699, and was widely read and admired. In 1710 he addressed a copy of verses to Lord Godolphin on his dismissal, and displayed his attachment to the house of Hanover by an elegant Latin dedication of an intended version of Lucretius to the elector, afterwards George I. On the accession of the latter he received the honour of knighthood, and was appointed physician in ordinary to the king, and physician-general to the army. He died 18th January, 1719.

GAS, the name given to any body in the aeriform condition. A distinction, which might with great advantage be abandoned, is made between vapours and gases. A body that usually presents itself as a liquid is commonly called a vapour when it becomes aeriform; while the name gas is confined to those bodies which are commonly found in that form. The splendid researches of Faraday, who liquefied nearly all the substances previously supposed to be *permanent gases*, and the later investigations of Andrews, who has unfolded to us every particular of the process of liquefaction, and has pointed out the conditions under which liquefaction is possible or impossible, have broken down the distinction which was previously considered to exist between gases and vapours; and the distinction in name is therefore only an inconvenience without corresponding advantage. Indeed, in Arctic regions, sulphurous acid and chlorine would be commonly known as liquids in winter, and consequently, when heated above the boiling-point, they should be called vapours; there are many volatile liquids, on the other hand, that would only be known as gases in tropical climates. We shall here therefore treat of gases of every description.

Both liquids and gases are termed fluids in comparison with solids: a fluid is distinguished from a solid by the free mobility of its particles—that is, in fact, by its want of rigidity. In a solid body the particles are so arranged as to be capable of resisting forces tending to change the shape of the solid. Neither a liquid nor a gas is capable of offering resistance to forces tending to change of shape, provided the change is made sufficiently slowly. Liquids and gases do, however, resist change of shape made at a finite speed. This resistance is of the nature of molecular friction. It is known under the name of *viscosity*, and the reader is referred to our article under that name for information on the subject.

Gases are broadly distinguished from liquids by their compressibility, and by the comparative smallness of their density. Thus water, mercury, alcohol, ether, are practically incompressible under any forces that we can apply. By an additional pressure of 15 lbs. to the square inch water is compressed only by $\frac{1}{21000}$ of its bulk. Mercury is even less compressible; alcohol and ether slightly more so. But, as will be explained immediately, an additional pressure of 15 lbs. per square inch applied to a mass of common air, taken at ordinary pressure, reduces the volume to one-half. Again, the density of water is 800 times as great as that of air at ordinary pressure and temperature; it is 11,400 times that of hydrogen, and 1600 times that of steam at boiling temperature and atmospheric pressure. When a small quantity of a liquid is put into a closed vessel it partly fills the vessel. It lies at the bottom of the vessel and is separated by a surface apparently quite distinct from the air above it. But when a quantity of a gas, however small, is put into a closed space, it expands and spreads itself uniformly through the space. It is by this last property that liquids and gases are practically distinguished. A liquid may be *defined* as an incompressible fluid, and a gas as a fluid that yields readily to compression.

Liquids are converted into gases by the addition of heat; and a gas is converted into the liquid state by the removal of some of the heat that it contains. Thus a quantity of liquid being put into a closed space, and heat being supplied, a certain quantity of it becomes gaseous. It *evaporates*, in fact, until as much gas has been formed as gives within the space in question gaseous pressure of an amount that depends solely on the temperature. The space is then completely filled with gas *at the same temperature* as that of the liquid. The heat that disappears in this process is called the latent heat of that mass of gas at the temperature in question. A space that contains as much gas as possible at any given temperature is said to be *saturated*. The gas in a saturated space is just on the point of condensing; and if the volume of the space were diminished, a portion of the gas would condense into the liquid form. Under these circumstances, if heat were abstracted, a portion of the gas would liquefy, and we should obtain a mixture of liquid and gas. The gas and liquid, therefore, differ from each other only in this, that the gas contains more heat than the liquid, and has in consequence the properties that we have described above.

The distinguishing property of gases is, as we have already explained, their power of indefinite expansion. All such bodies obey more or less strictly two laws, which are commonly called the 'gaseous laws.' The first is called Boyle's law. It was given by Robert Boyle in 1662, in his Experiments Touching the Spring of Air. It is known by Continental writers as Mariotte's law, and by the readers and translators of those writers as the law of Boyle and Mariotte. But it was not till 1676 that Mariotte enunciated it. Boyle's law is that—*The volume of a given mass of gas varies inversely with the pressure to which the gas is subjected.* Thus if a quantity of gas is contained in a cylinder with a movable piston, the pressure on the piston must be doubled in order to reduce the volume to one-half, trebled to reduce the volume to one-third, and so on. Again, if the volume of the cylinder is increased by drawing back the piston, the pressure of the gas on the piston is found to be diminished in the same ratio as the volume is increased. If the volume is doubled or trebled, the pressure is reduced to one-half or one-third.

The following is plainly another way of stating this law:—The *density* of a given mass of gas is in simple proportion to the pressure that the gas is subjected to. A third statement, proposed by Rankine, is, however, perhaps more instructive than either of the former, when we come to consider the kinetic theory of gases. Let any mass of gas, a grain of common air say, be introduced into a vessel which has been completely exhausted by means of an air-pump. The air will spread itself through the vessel, and exert a certain pressure per square inch on the sides of the vessel. Let a second grain of air be now introduced: this second grain will exert exactly the same pressure on every square inch of the vessel as if the first grain were removed. Each square inch will therefore now support double the pressure that it was exposed to before the second grain was introduced. So if a third and a fourth grain be introduced, the pressure will be trebled or quadrupled. The pressure is thus proportional to the quantity of the gas introduced; that is, since the volume of the vessel remains unaltered, to the density of the gas. Dalton's law for the pressure of mixed gases, which states that each gas of a mixture exerts on the containing vessel the same pressure as if all the other gases were removed, is thus seen to be an extension of Boyle's law.

The second of the gaseous laws is commonly called the law of Dalton and Gay-Lussac. It is, however, properly called Charles' law. Dalton published it in 1801; but Gay-Lussac, who stated it in 1802, gives the credit of having discovered it, fifteen years previously, to Citizen Charles. The law may be stated as follows:—The volume of a gas maintained under constant pressure increases for equal increments of temperature by a constant fraction of its original volume; and this fraction is the same whatever is the nature of the gas. A mass of gas, whose volume is 1000 at 0° C., becomes, at 100° C., 1366·5, the pressure remaining constant. The two laws that have just been stated may be combined into a formula fitted for calculation in the following way:—Let V represent the volume of a gas at the temperature $t°$ Centigrade and pressure p, expressed in inches or millimetres of mercury, as in the common way of reckoning barometric pressure, and let V' be the volume at any other temperature $t'°$ and pressure p', then—

$$V' = V \frac{1 + 0{\cdot}003665\ t'}{1 + 0{\cdot}003665\ t} \times \frac{p}{p'};$$

or $V' = V\,[1 + 0{\cdot}003665\ (t' - t)]\ \frac{p}{p'}$ very nearly.

From either of these formulas any one of the six quantities, $V\ V'$, $t\ t'$, $p\ p'$, may be calculated, the other five being given.

We have stated above that all gaseous bodies conform to these laws more or less exactly. There is no known gas that obeys them perfectly; but in the consideration of thermodynamic principles the conception of a 'perfect gas' is employed just as perfectly rigid bodies are assumed in dynamics and perfect fluids in hydrodynamics, and experiments make it highly probable that any substance in the gaseous condition approaches more and more nearly to the condition of a perfect gas as the temperature of it is raised more and more. A perfect gas may be defined as a body which obeys the laws of Boyle and of Dalton or Charles exactly. We now proceed to consider the deviations from the gaseous laws exhibited by the gases that we are acquainted with.

Every known gas has now been liquefied, but six only with great difficulty. These six are oxygen, hydrogen, nitrogen, carbonic oxide, nitric oxide, and light carburetted hydrogen gas; and it is these gases that obey the laws of a perfect gas most nearly. All of them, except hydrogen, are, however, slightly more compressible than they should be, according to Boyle's law; and this deviation becomes more and more marked as the gas becomes more and more condensed, and also as the temperature at which the experiment tried is lowered. Hydrogen appears to deviate slightly in the opposite direction from Boyle's law, being slightly less compressible than it should be. Hydrogen is the only gas in which this has been observed, and recent experiments seem to show that at high temperatures the peculiarity disappears. On examining other gases besides the six mentioned above it is found that they exhibit deviations from Boyle's law to a far greater extent, and that as the gas is brought nearer and nearer to liquefaction by the application of pressure or of cold, or of both, the amount of the deviation rapidly increases. When the gas is just about to liquefy the law of Boyle is not obeyed even approximately, and as soon as liquefaction has begun the whole of the gas may be liquefied by merely diminishing the volume of the space occupied by it without the necessity for applying any more pressure. It must be understood here that the temperature remains constant; and this provision necessitates the removal of the latent heat of the gas which is given out during liquefaction.

The law of Dalton or Charles, which gives for equal elevations of temperature equal increments of volume, is also deviated from by every known gas, and more and more so as the point at which liquefaction occurs is approached.

The liquefaction of all gases is effected by the application of cold or pressure, or both combined. For any given pressure there is a particular temperature at which the gas liquefies. Thus carbonic acid gas liquefies under a pressure of 38·5 atmospheres at 0° C., at 13° C. it liquefies under 49 atmospheres, and at 21° a pressure of 60 atmospheres is necessary to liquefy it. The gas and the liquid, when they are near the liquefying point, are found to be in a very remarkable condition. We have stated above that liquids under ordinary conditions are scarcely compressible at all. The expansion of liquids by heat is also very small in comparison with that of gases. But close to the point at which the liquid is about to become a gas the expansion increases enormously; the compressibility does so also: thus Andrews has shown that carbonic acid near to its boiling-point is highly compressible, while Thilorier showed that the expansion of *liquid* carbonic acid is greater than that of any known gas. When the properties of the liquid on the one hand, and of the gas on the other, are examined at and about the boiling-point as the temperature rises, the modifications of them become more and more striking. Carbonic acid has been examined by Andrews at various temperatures under such pressures as brought it just to the point of being liquefied if gaseous, or of being converted into gas liquid. The properties of the liquid and the gas gradually merge into each other. But at a certain point, called by Andrews the *critical point of temperature*, the distinction between liquid and gas appears completely lost. At and above this temperature no pressure that can be applied will convert the fluid into the form of a liquid, even though the volume is diminished by pressure so much as to make the density of the fluid greater than that of the liquid carbonic acid obtained at lower temperatures. Andrews, observing the gradual modification of the liquid and gaseous properties of the fluid when near to the critical point of temperature, has pointed out the '*continuity* of the liquid and gaseous states of matter.' See MATTER (CONTINUITY OF LIQUID AND GASEOUS STATES OF).

The six gases mentioned above as extremely difficult to liquefy all resisted the attempts of Faraday to reduce them to a liquid condition, and they were hence long known as *permanent gases*. "Oxygen remained gaseous under a pressure of 27 atmospheres at a temperature of −166°, and a pressure of 58·5 atmospheres at −140° was equally ineffectual in producing its liquefaction. Nitrogen and binoxide of nitrogen resisted a pressure of 50 atmospheres; with carbonic oxide a pressure equivalent to that of 40 atmospheres, with coal-gas one of 32, and with hydrogen one of 27 atmospheres was applied without effecting the liquefaction." With most of these gases success has only recently been achieved. See LIQUEFACTION OF GASES.

It now remains for us to give a very brief account of the kinetic theory of gases, the greatest, we might almost say the only advance that has yet been made in the construction of a molecular theory of the constitution of bodies.—Daniel Bernoulli seems first to have suggested that the pressure of a gas is due to the impact of its molecules on the sides of the containing vessel. Lesage, Prevost, Herapath, and others, made some applications of the theory. Joule calculated the velocity of the molecules necessary to produce the pressure of the gas under certain circumstances. It is, however, to Professor Clausius and Professor Clerk Maxwell that we owe the complete development of the theory that we now possess. All bodies are looked on as being made up of molecules of definite dimensions. These are not to be considered as infinitely hard indivisible 'atoms,' such as Lucretius supposed; indeed, in one sense the doctrine of infinite divisibility of matter is not untenable in conjunction with the molecular theory now propounded: but, division having been carried to a finite limit, we reach constituent molecules of the substance, and farther subdivision, if it were possible, would deprive the molecules of the peculiar properties that distinguish the substance to which they belong. Some of these molecules are, so far as we know at present, simple: hydrogen, oxygen, and carbon, for example, have not yet been broken up into any simpler constituents; others we know to be compounds in which two or more simple molecules are joined together to make up a compound molecule, and these simple molecules are bonded together in such a way that the separation of them is the destruction of the compound. Therefore, whatever are the molecular motions of one of the constituent molecules, they are performed in concert with the other constituent molecule. The two, in fact, move joined together, and inseparable without destruction. Heat is intermolecular motion: and every hot body is in motion. The hotter the body the greater is the energy of the motion. In a solid body the component molecules are firmly bound together, they do not move out of their relative places. The molecules must therefore move in very small orbits; and the motion must be such as is consistent with its keeping its position relative to other molecules unaltered. In a liquid this is not the case. The molecules are able to move from place to place, and to change their places relatively to other molecules; and in liquid diffusion we find this transference of particles actually taking place. In the case of a liquid, however, the path is very much disturbed by encounters with other molecules. A particle cannot go far without meeting another particle: but the molecule does not necessarily return as in the case of a solid, after the encounter, into the region it occupied previously. It is the circumstances of its original motion, and those of the motion of the molecule with which it has been in collision, that determine whether, after collision, it shall move back towards its old position, or whether it shall move on into new regions. A gas consists of an enormous number of molecules moving about with very great velocity. Great as is their number, however, the molecules are sparsely distributed through space, in comparison with their distribution when the substance is in the solid or liquid condition. What the actual size of the molecule is we have no means of estimating; but we have some idea as to the distance at which there is an intense exhibition of force between any two molecules. If we call the space around the molecule through which this intense force is exhibited, the sphere of action of the molecule, then we may say with respect to the distribution of the molecules of a gas through any space that they are so sparsely scattered through it that the average distance from molecule to molecule is many times as great as the diameter of the sphere of action of the molecules. A molecule of a gas flying about moves on in a straight line till it meets another molecule, or till it impinges on a side of the containing vessel. Meeting another molecule the two turn each other aside, just as two billiard balls when they come into collision are both deflected from their previous paths. Passing thence each flies on in a straight line till it meets a fresh molecule, and each is again deflected. When the molecules impinge on the side of the vessel that contains the gas they rebound as a billiard ball does from the cushion of the billiard table; and the perpetual shower of molecules that strike and rebound from the sides, gives rise to the phenomenon of gaseous pressure, just as an umbrella held out in a hail storm is pressed downwards, owing to the numerous impulsive blows that act upon it. When the temperature of a gas is raised the energy of the molecules is increased. They strike with greater velocity, and the number of blows on the side of the vessel is also increased. The pressure is therefore greater; and the law of Dalton or Charles is easily shown to be a consequence of the kinetic theory. Boyle's law also follows very simply from it; for if we diminish the volume of the containing vessel to one-half, one-third, or to any other fraction of its original volume, we increase the number of molecules in a given space, a cubic inch for instance, in the same ratio. Consequently, the number of impacts on a square inch of the surface of the containing vessel will also be increased in the same ratio, and the pressure will thus be increased in that ratio too. The reader is recommended to consider here Rankine's statement of Boyle's law given above.

It is impossible in an article like the present to give a full account of this beautiful theory, but the following analogy of Professor Clerk Maxwell, by means of which we may compare liquids and gases, cannot be omitted. Imagine a swarm of bees flying about in all directions. The swarm may be gradually moving on in some particular direction as a whole, but every one knows that no one bee flies straight in the direction in which the whole swarm is moving: all of them fly more or less backwards and forwards, though the average motion is in a fixed direction. Here we have an excellent analogy of a mass of gas moving as a whole in a given direction. The bees all flying about when they meet each other turn aside to avoid collision. If each bee were always to fly in a straight line till it met another bee, or a solid obstacle, and not to turn aside for any other reason, the analogy would be perfect. We might imagine that half of the bees are marked with pollen, and that the other half have no pollen at all. And at some particular instant let all the marked bees be on one side of a particular plane, and all the unmarked ones on the other side. As they are all flying about and turning only when they come into collision, it is plain that after a while some of the marked bees would

be mixed with the unmarked bees, and some of the unmarked bees would have penetrated among the marked ones. After a longer interval the mixing would be more complete, and finally the two kinds would be equally distributed. Calculating with the aid of the laws of probability the law for mixture of the marked with the unmarked bees, it is found to be precisely the same as the law according to which two gases, such as oxygen and hydrogen, contained at the beginning of an experiment in separate vessels, and then put mouth to mouth, would diffuse each into the space previously occupied by the other.

The analogy may, as we have said, be made to suit the case of liquids also. Let the bees now be supposed to have settled in a vast heap. Then, it is evident, that intermixture or diffusion will go on much less rapidly. Any particular bee may, after some time, crawl from the lower part of the heap up to the top. It will be much impeded by meeting other bees creeping to and fro. Sometimes it will, owing to circumstances, be actually turned backward, so as to be going in the downward direction; and chances may cause even it to reach the bottom of the heap before it gets to the top; but if, as we supposed above, half of the bees at one side of the heap were marked, and the other half unmarked, sooner or later complete mixing would be accomplished. The analogy suits precisely the case where water is put at the bottom of a jar, alcohol floated on the top, and the whole left to itself. Diffusion goes on gradually, and the mixture will sooner or later be complete.

We regret that our limits make this sketch so brief and meagre. We might show how the combination of two gases, such as oxygen and hydrogen, takes place when a spark is applied to the mixture, by pointing out that the energy of some particular molecules becomes so great that a molecule of oxygen, instead of turning aside when it meets a molecule of hydrogen, dashes within what we called the sphere of action of the molecules: intense attraction then takes place, and chemical combination is the result. We might point out how the velocities of the molecules may be calculated; we might expatiate on diffusion, conduction for heat, viscosity of gases, and on many other points. But we must content ourselves with recommending to our readers the full exposition of the theory given in Professor Clerk Maxwell's Theory of Heat, and in his many admirable published papers.

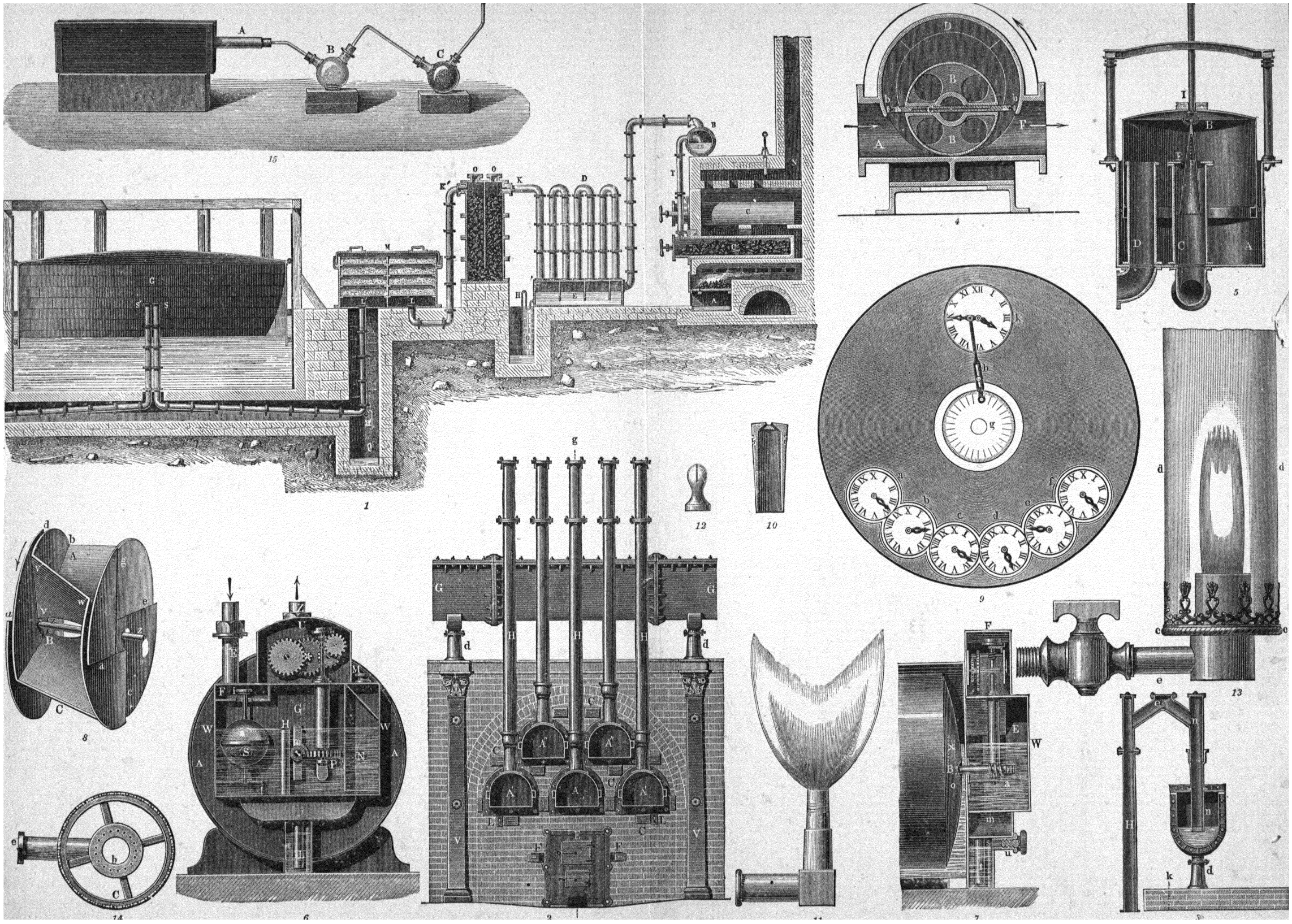
GASCONY (Lat. *Vasconia*), an old division of France, situated between the Garonne, the sea, and the Pyrenees. It formed part of the government of Guienne and Gascony, and composes at present the departments of Hautes Pyrénées, Gers, and Landes, with part of those of Bas Pyrénées, Haute Garonne, Lot-et-Garonne, and Tarn-et-Garonne. The Gascons used to have a peculiar character attributed to them, from which and their provincial pronunciation they were often subject to ridicule. They were considered brave, faithful, and peculiarly tenacious of purpose, but much given to boasting, whence the word *gasconnade*.

GASKELL, Elizabeth Cleghorn, a distinguished authoress, was born at Chelsea, 29th September, 1810. Her father, William Stevenson, had been a Unitarian minister, but was latterly keeper of treasury records in London. She was brought up by an aunt at Knutsford in Cheshire, where she spent the greater part of her early life. This town is said to be the original of the village in her story of Cranford, described as inhabited exclusively by maiden ladies and widows of limited means. She married in 1832 the Rev. William Gaskell, a Unitarian clergyman then recently appointed minister of Cross Street chapel, Manchester, and she died at Alton, Hampshire, 12th November, 1865. Mrs. Gaskell was chiefly a writer of fiction. Her first work, Mary Barton, appeared in 1848. The Athenæum says it raised the Lancashire dialect almost to the level of the broad Doric used by Scott in his northern novels. In this, as in most of her works, Mrs. Gaskell appears as a social reformer. She borrows largely from her observation and experience as a clergyman's wife in depicting the ills of society. Her moral and economical theories may be questioned, but as a writer of fiction she wields artistic and dramatic powers of a high order. Mary Barton represents the struggles formerly so rife in Lancashire, and which have since passed into new phases and into other quarters, between workmen and employers. Mrs. Gaskell had already contributed to Howitt's Journal and other periodicals, and from its commencement in 1850 she became a regular contributor to Household Words. The Moorland Cottage, a Christmas story, appeared in the winter of 1850; and in January, 1853, her next regular novel, Ruth, which aims a distinct blow at the common moral judgments of society. The tale is powerfully told, but it will hardly satisfy a dispassionate reader of the soundness of Mrs. Gaskell's moral theories. Lizzie, Cranford, and other minor tales appeared at various times in Household Words. In the same periodical she wrote her next novel, North and South, a Yorkshire tale, in which again appears a strong disposition to right wrongs of which it is much easier to point out the existence than the remedy. In 1857 appeared a Life of Charlotte Bronte, interesting both for its subject and mode of treatment, but in which the writer's disposition to be guided by her feelings led her into various errors, one of which, affecting the character of a lady, she afterwards freely retracted. Of this work the Athenæum says, 'As a work of art we do not recollect a life of a woman by a woman so well executed.' Sylvia's Lovers appeared in 1860, and Wives and Daughters, which she had been writing for a periodical at the time of her decease, appeared without the final chapter, but complete as a work of art, in 1866. It is considered one of her best works.

GASKET, a sort of plaited cord fastened to the sail-yards of a ship, and used to furl or tie up the sail firmly to the yard by wrapping it round both.

GAS-LIGHT, in the most common meaning, the light given by coal-gas as employed in the lighting of buildings and streets. In 1739 the Rev. Mr. Clayton published a paper in the Philosophical Transactions, detailing his experiments on the inflammable nature of the gases obtained by the decomposition of pit-coal in heated close vessels; but he had made the discovery long before, as he alludes to it in a letter addressed to the society in May, 1688. Yet no practical application of this discovery was even hinted before 1792. In this year Mr. W. Murdoch, or Murdock, a native of Ayrshire, but at the time of which we speak residing at Redruth in Cornwall, in the employment of Messrs. Watt and Boulton, made extensive experiments on the illuminating properties of gases obtained by distilling coal, wood, peat, and other combustible substances, which led him to the idea of collecting these gases in vessels, and expelling them through jets for light, and on this principle he lighted his own house and offices at Redruth. In 1798, having by this time returned to Birmingham, he erected a gas apparatus on a large scale at Soho Foundry. On the rejoicing for the Peace of Amiens in 1802 the whole front of the Soho works was illuminated by Mr. Murdoch's gas apparatus. In the same year M. Le Bon lighted his house in Paris by gas obtained from wood and coal, and made a proposal to supply the whole city;

GAS APPARATUS.



1. Sectional View of Small Gas-Work. Retorts, Furnace and Hydraulic Main, Coolers, Coke Condenser, Lime Purifier, Gasholder **2** Elevation of Gas-Retort Furnace. **3** Section of Retort Delivery-Tube and Hydraulic Main. **4.** Exhauster. **5.** Governor. **6.** Meter - Sections. **9.** Dial of Station Meter. **10, 11** Union Burner. **12.** Slit or Bat wing Burner. **13, 14.** Argand Burner. **15** Apparatus for Destructive Distillation.

but Lampadius had hinted at the practicability of such a thing the previous year. In 1805 a gas-lighting apparatus was erected at the factory of Messrs. Philips and Lee of Manchester. The first gas company, the National Light and Heat Company, was then established, and in 1809 Pall-Mall was thus lighted. From this time onwards gas became practically the universal illuminating agent wherever it could be made economically, improvements upon the apparatus being from time to time introduced. Latterly, however, as a source of light, coal-gas has been giving way to electricity. Acetylene gas (see ACETYLENE) has more recently come into use as an illuminant. Gas made from shale-oil or petroleum is also used, especially in lighting railway-carriages, being compressed for this purpose.

The best sorts of coal for gas-making are those bituminous coals known in England by the name of *cannel*. The coal is distilled in retorts of cast-iron, or now more generally of fire-clay, heated to a bright-red heat, the process being that known technically as destructive distillation. The result is the separation of the volatile constituents from those that are fixed and must be left behind as residue (coke). In order to get the gas for burning as pure as possible, various products at first mixed with it have to be got rid of. This is partly accomplished by cooling, a process which gives us gas, more or less impure, coal-tar (a dark viscous substance), and water, the latter containing ammoniacal compounds in solution. Before the gas is fit for use, ammonia has to be removed by washing, and other substances have also to be eliminated, such as carbonic acid and sulphuretted hydrogen, and the amount of the resulting gas has also to be measured. As the gas is never given off from the retorts in uniform quantities, it must be temporarily stored up after purification in a gas-holder, from which it is discharged into the street or other mains in the constant stream necessary to produce a steady flame from the burners. The manufacturing apparatus must therefore be so constructed as to fulfil all the above conditions. Gas-works vary in size very greatly, from the small work that may be constructed to furnish light to a mansion-house and connected offices, to the huge works erected for the supply of a large city. And in the latter case the gas is often largely consumed not only for lighting but also for heating, for driving gas-engines, &c. The process of gas-making will be readily understood from the accompanying plate, which gives a sectional view of a small gas-work. A is the furnace, with its set of D-shaped retorts (marked C C in fig. 1, A in front view, fig. 2). The retorts are built horizontally into an arched oven, in such a manner as to be equally heated from the furnace beneath. The most common sizes of retorts are from 6 to 9 or 10 feet in length, and from 12 to 20 inches in diameter; in large works two 9-feet lengths are joined together, forming one retort 18 feet long, with a mouth at each end. The neck or mouth-piece of the retort is of cast-iron, and projects so far from the front of the oven as to admit the insertion of the ascension pipe (T, fig. 1, or H, figs. 2, 3). This pipe conveys the gas to the hydraulic main (B, fig. 1), a large pipe made of thick plate or cast-iron (see fig. 3). From this vessel, again, rises the pipe which conveys the gas to the condenser (D, fig. 1), thence to the washer (O), then to the lime-purifier (M), and lastly to the gas-holder (G).

The operation of gas-making proceeds in the following way. The coals are introduced into the retort (C) by means of a long narrow scoop or shovel. The mouth of the retort is then closed by a lid, fixed tightly by means of a screw and holdfast, the joint being in some cases made tighter by luting with clay. The gases which are generated escape by the upright tube into the hydraulic main (see sectional view, fig. 3). A tarry liquor is here deposited, which is discharged when it rises above half the horizontal section, by an overflow-pipe at the end of the main into the tar-well. By this tarry liquid the orifices of the pipes from the retorts are closed, whereby the gas is prevented from descending into the retort-pipes. The hot gas which passes from the main still holds in suspension a considerable portion of tarry and ammoniacal vapours, which must be abstracted, or they would condense in the distant parts of the apparatus. The gas is therefore made to pass through the condenser (D), consisting of a number of upright tubes, in which the gas alternately ascends and descends, the cooling being effected by the external air simply, or assisted by water. The gas in passing through these cooled tubes is considerably reduced in temperature, and the waste products condense into tar and ammoniacal liquor in the iron box E, being then led by a syphon-pipe (H) into the tar well (Q, fig. 1). The exhauster (fig. 4), when used, is the next part of the apparatus. It is a kind of pump or suction apparatus which relieves the retorts of the resistance or pressure created in the passing of the gas through the apparatus, and in raising the gas-holders. In the form shown the drum B turns on an eccentric axis, and two sliding pieces form a double diaphragm at C. At the outer end of each piece is a pin *b b*, which travels in a groove cut in the casing, so that by the revolution of the drum the sliding pieces are drawn out according to position. The case is fitted with a stuffing-block, through which the axle of the drum passes for the application of the driving power. When the axle is set in motion the sliding pieces are carried along with it, and are drawn in and out, the ends being always in contact with the casing. As the axle revolves, the slides catch gas entering at A, and drive it out at F. A portion of the ammonia and the sulphuretted hydrogen and carbonic acid have still to be got rid of. For this purpose the coke-condenser or scrubber is employed, in which the gas is made to pass through layers of coke, through which water may be made to percolate from the openings O, O, fig. 1. The gas then passes on to the lime-purifier, by means of which it is purified from the sulphuretted hydrogen, a portion of the ammonia, and the carbonic acid. There are two kinds of purifiers, the dry and the wet. The dry purifier, M, fig. 1, is a rectangular iron vessel, containing a series of perforated trays, on each of which the purifying material is placed. Slaked lime is used in this purifier in layers of from 2½ to 3½ inches on each tray. The vessel is divided into two compartments by a partition extending not quite to the top; the gas filters up through one compartment and down through the other. As the smell of the spent lime is very offensive, oxide of iron is frequently substituted, and is used in the same manner, but spread on the trays to a greater thickness. A separate lime purifier, however, is necessary for removing the carbonic acid. The wet lime purifier, now seldom used, is a cylindrical vessel, into which the gas is conveyed by a wide pipe, which descends through the centre of the vessel, and is furnished with a broad flange on the lower end. The vessel is filled with a mixture of lime and water to the height of several inches above the flange. The gas passes under the flange, and forces its way up through the purifying material, which is constantly kept in motion by a stirrer, which consists of two revolving arms driven by a spindle passing through a stuffing-

box in the centre of the cover of the vessel The gas now passes through the station-meter (fig. 9), which registers the quantity of gas produced at any given hour. The internal construction of this apparatus is similar to that of the consumer's meter to be described afterwards. In connection with it there is a *tell-tale*, which indicates every irregularity in the production of the gas during the twenty-four hours. In the centre of the dial-field a circular plate is fixed, connected with a train of wheel-work, set in motion by an inclosed drum, through which the gas passes, indicating tens, hundreds, thousands, &c., of cubic feet of gas. Upon this circular plate is fixed a disc of paper, *g*, over which is placed a timepiece, to the minute hand of which is attached a detent, furnished with a pencil, pressing by a spring upon the disc. As the minute hand revolves, the pencil, by means of a guide fixed in the meter-case, is regulated, so that in the first half-hour it will trace a perpendicular line on the paper in length equal to the diameter of the circle formed by the minute hand, measured from the centre to the point at which the detent is fixed; in the second half-hour the line would be retraced by the hand rising again. This arrangement supposes the disc to be stationary, but as it is made to revolve upon an axis, which is also the axis of the inclosed drum, the pencil will make a series of curved lines, meeting the divided circle of the disc every hour, and the distance travelled from point to point will mark the number of cubic feet of gas made every hour. If the production has been regular the pencilled figure will also be so; if any neglect has occurred it will be detected by the irregularity of the figure, and the hour and amount of difference indicated.

From this meter the gas is next conveyed to the gas-holder. This is a large cylinder closed at the top and floating or suspended with its open end in a tank of cast-iron or masonry, containing water. A pipe S (fig. 1) ascends from the bottom of the tank through the water to admit the gas to the space between the water and the crown of the gas-holder. Another pipe S′ descends through the water and the bottom of the tank, by which the gas is introduced into the street mains. The buoyancy of the gas raises the holder, the weight of which, or as much of it as is not taken off in some instances by balance-weights, impels the gas through the pipes. The balance-weights are attached to the edge of the crown of the gas-holder by chains, which pass over pulleys on the top of columns, which serve also to guide the motion of the vessel in rising or falling. In large works a telescope gasometer is used, and economy of space and cost thereby effected—two or more concentric cylinders being contained in one tank.

In many works before the gas enters the mains its pressure is regulated by the governor (fig. 5). This consists of a cast-iron tank (A) containing water in which the regulating vessel (B) floats; F is a cast-iron cone suspended from the top of the floating vessel; C is the pipe by which the gas enters; on the top of this pipe is a plate E, furnished with an aperture which fits the diameter of the cone at the base, so that if this were raised to its full height it would completely shut off the gas, and prevent it from entering the vessel and escaping by the outlet pipe D into the street-mains. It is evident, therefore, that if the pressure of the gas in the inlet pipe is increased, a larger quantity must pass between the sides of the cone and the opening in the plate, the consequence of which will be that the floating vessel will rise and contract the area of the opening; if, on the other hand, the pressure of the gas in the inlet pipe is decreased, the vessel will descend and enlarge the opening; so that whatever pressure there may be in the gas-holders, the pressure on the floating vessel will be uniform, and the velocity of the gas passing into the mains will thus be regular; for when the aperture E would admit more gas than is necessary for supplying the mains the floating vessel rises and diminishes the opening; or when the inlet does not allow a sufficient quantity of gas to come from the holders, the gas passes out of the governor into the mains, and the vessel descends and increases the orifice of the inlet pipe to admit more gas into the mains. The mains are large cast-iron pipes, each of about 9 to 10 feet in length, and should be carefully jointed, and laid with as few changes in their inclination as possible; but as such changes cannot be always avoided, it is necessary to provide for the removal of water, which, suspended in the gas in the form of vapour, condenses in the pipes and lodges at low points. To effect this a vessel is connected with the main, and the water is removed by a pump. Where little condensation is anticipated, a small pipe is attached to the main, with a stop-cock to run off the water. The small pipes in the interior of buildings should be laid evenly, with an inclination towards the meter; where this is not possible, a box or drip-cocks should be provided for the reception and removal of water.

The quantity of gas used by each consumer is measured by an instrument called a meter, of which there are two classes—the wet and the dry. The wet-meter consists of a cylindrical case (AA, fig. 6), within which is a shorter cylinder or drum revolving on a horizontal axis inside the case, the pressure of the gas being the motive power. This drum (fig. 8) is divided into four chambers, A B C, running in a slanting direction from back to front. A convex cover is fixed on one end of the cylinder. This cover is pierced to admit the pipe by which the gas enters the cylinder; the orifice being below the surface of the water, with which the outer case is somewhat more than half-filled. The pipe, after entering the opening, is turned up till its mouth is above the surface of the water. The gas thus admitted within the cover forces its way through a slit *a c e g* into one of the four chambers into which the drum is divided. The chamber which comes first into action is almost entirely under the water. The gas passes between the water and the partition of the chamber, which it raises and fills. The outlet slit *d* of the chamber is on the side of the cylinder opposite to the inlet slit, and is open to the case of the meter. It is not, however, on the same plane, but is so arranged that it remains sealed under water till the chamber is filled with gas, by which time the revolution of the cylinder has brought the inlet slit of the next chamber above the water, and it is ready to receive the gas. The filling of the second chamber carries round the one already filled, causes its descent into the water as it revolves, and expels the gas by the outlet slit. Two chambers are in action at one time. On the front of the case of the meter is a box into which the axis of the drum extends, having a spiral worm-wheel on its end. The worm-wheel communicates motion to a vertical spindle which moves the train of wheels which carry round the hands of the index. The front box contains also the filling and overflow pipes for the supply and adjustment of the water, the entrance-chamber by the gas is admitted, and in which the valve is placed. This valve is kept open by a float, which descends, closes the valve, and shuts off the gas when the water is too much depressed by evaporation or leakage. This form of meter has several disadvantages. In cold weather the water is apt to freeze, and the passage of the gas is completely stopped; if the water-level is lowered, more gas will pass than can be registered, or if the meter be tilted forward no registration will be effected at all; so that a dis-

honest consumer could defraud the gas company. To get rid of these objections the dry-meter was invented. In the dry-meter the gas is measured by the number of times that a certain bulk will fill a chamber capable of undergoing contraction and expansion by the passage of gas. These alternate contractions and expansions of the chamber communicate motion to certain valves and arms of simple construction, which, by the aid of a few wheels, carry round the hands of the dials. In one form of the meter are three chambers, separated from each other by flexible partitions of leather, partially protected by metal plates. The pressure of the gas expanding the partitions causes them to assume a conical shape, the motion of which backwards and forwards on both sides sets the measuring machinery in motion. By an action in some respects similar to that of a three-throw pump a continuous current of gas is thrown out of the machine, it having been found that with only two partitions the lights were liable to oscillation. The constant bending of the leather soon causes this instrument to get out of order, one partition may give way without being discovered, and a great quantity of gas may thus be consumed without being registered. To remedy these defects a meter has been invented by Messrs. Croll & Glover, in which leather is certainly used, but merely to form a flexible band, which does not take part in the measuring. The meter is thus described by Mr. Croll: —'It consists of a cylinder divided by a plate in the centre into two separate cylindrical compartments, which are closed at the opposite ends by metal disks; these disks serve the purpose of pistons, and are kept in their places by a universal joint adapted to each; the space through which the disks move, and consequently the means of measurement, is governed by metal arms and rods, which space, when once adjusted, cannot vary. To avoid the friction attending on a piston working in a cylinder a band of leather is attached, which acts as a hinge, and folds with the motion of the disk; this band is not instrumental in the measuring, so that if it were to contract or expand the registering of the meter would not be affected, inasmuch as it would only increase or decrease the capacity of the hinge, the disk being still at liberty to move through the required space; the leather is also distributed in such a manner, being curved and bending in only one direction, that it prevents any wrinkles or creases forming, and renders it, therefore, much more durable. The arrangements of the arms and valves are somewhat different to that of a steam-engine, although similar in principle.'

The profitable consumption of gas, whereby the strongest light can be had at the least expenditure of gas, depends considerably upon the form of the burner, and the mode by which the flame is fed with the air necessary for its combustion. There must be a sufficient supply of oxygen to convert the carbon of the gas into carbonic acid, and the hydrogen into water. If there is not a sufficient supply of oxygen, the flame will be smoky from excess of carbon. In this case the remedy is either to reduce the supply of gas or increase the supply of air. This may be effected by modifying the form of the burner or in the case of the Argand burner by having a different shape of glass chimney. As to the form of the burner, it has been found that a plain jet ½ inch in diameter at the orifice, will not give a flame free from smoke of a greater height than 2½ inches; but the same quantity of gas which would give a smoky flame from a plain jet, will produce a clear bright flame by extending or dividing the aperture of the jet so as to expose a larger surface of flame to the atmosphere. It is not, however, necessary to increase the superficial area of the flame; it may even be diminished with a more intensely luminous effect by having instead of one aperture two small ones pierced at an angle to each other, so that the jets may cross each other. This forms the union jet (figs. 10, 11). Another form is the slit or batwing burner, in which a clean slit is cut across the top of the beak (fig. 12). In the Argand burner (figs. 13, 14) a circle of small holes (b) supplies the gas, and a current of air is admitted through the centre of the flame, which is steadied and considerably increased in brilliancy by being surrounded by a glass chimney, resting on the circular support (c). In burners of the so-called regenerative or recuperative type the air supplied is previously heated by the hot waste products of combustion, and thus the gas is more perfectly burned, and the light is whiter and more brilliant. The names of Wenham, Siemens, Schulke, &c., are well known in connection with these. The Welsbach incandescent light is also very commonly used.

GASSENDI (properly GASSEND), PIERRE, an eminent French philosopher and mathematician, was born in 1592, at Champtercier, near Digne, in Provence. At the age of nineteen he was appointed to fill the vacant chair of philosophy at Aix, where he had studied, and although the authority of Aristotle was still warmly maintained, he ventured publicly to expose the defects of his system. His lectures on this subject, which were published under the title of Exercitationes Paradoxicæ adversus Aristotelem (Grenoble, 1624), gave great offence to the votaries of the Aristotelian philosophy, but obtained him no small reputation with Peiresc and other learned men, through whose interest, after being induced to take orders, he was presented to a canonry in the cathedral church of Digne, and made Doctor of Divinity. A second book of Exercitationes excited so much enmity that he ceased all direct attacks on Aristotle, although he still maintained the predilection he had formed for the doctrines of Epicurus, which he defended with great learning and ability. He strenuously maintained the atomic theory, in opposition to the views of the Cartesians, and, in particular, asserted the doctrine of a vacuum. On the subject of morals he explained the doctrines of Epicurus in a sense the most favourable to morality. He was appointed lecturer on mathematics in the Collége-Royal at Paris in 1645. Here he delivered lectures on astronomy to crowded audiences, and by his great application so injured his health that he was obliged to return to Digne in 1647, from which place he did not return until 1653, when he published the lives of Tycho Brahe, Copernicus, Peurbach, and Regiomontanus (John Müller). Having resumed his astronomical labours with an intensity which the state of his health did not permit, his health rapidly gave way; his death, which took place on the 25th Oct. 1655, was further hastened by the copious bleedings so much in favour with the physicians of that age. He is ranked by Barrow amongst the most eminent mathematicians of the age, and mentioned with Galileo, Gilbert, and Descartes. Gassendi was the first person who observed the transit of Mercury over the sun. The MSS. which Gassendi left behind him, and the treatises published during his life, were in 1658 collected by Sorbière, in six volumes, folio, and published at Lyons; and by Averrani, also in six folio volumes, at Florence, in 1728. His chief works are on the life and doctrines of Epicurus (De Vita Moribus et Doctrina Epicuri, Lyons, 1647; Syntagma Philosophiæ Epicuri, Lyons 1649), on astronomy (Institutio Astronomica), the lives of Tycho Brahe, Copernicus, Peurbach and Regiomontanus (Tychonis Brahæi, Copernici, Peurbachii et Regiomontani Vitæ, Paris, 1654); refutations of Descartes' epistles, and other treatises.

GAS-TAR. See TAR.

GASTEIN, or WILDBAD GASTEIN, a watering-place in Austria, in a romantic district, 3000 feet above the sea, 48 miles south of Salzburg, with thermal springs varying from 64° to 100°, and containing some salt and carbonates of magnesia and lime. The place gives the name to a treaty signed here in 1865 by the Emperor of Austria and the King of Prussia, the nonobservance of the terms of which led to the German war of 1866.

GASTEREN, a valley in Switzerland, on the south frontiers of canton Berne. It is situated west of the Blumlis Alp, and is almost unsurpassed in savage grandeur, having for its back-ground the great Tschingel glacier, flanked by the lofty summits of the Schilthorn and Sackhorn.

GASTEROPODS, a very large class of the subkingdom MOLLUSCA. The name is given on account of the characteristic mode of progression, the inferior surface of the body forming a flattened sole or disk, by the contractions of which the animal advances. In all these animals the primitive symmetry of the body is obscured by the unequal development of parts, whence results the spiral disposition of the majority. When a shell is present it consists of only one piece, whence the name univalve, formerly applied to the class; or if of more than one piece the separate portions are placed one behind the other in the axis of the body. The Gasteropods agree with the Cephalopods in possessing a lingual ribbon, but are separated from that class by the greater symmetry of the latter, by the mode of formation of their shell, and by the arms which surround the head of the cuttle-fish. The lingual strap or odontophore consists of a central portion (*rachis*) and lateral pieces (*pleuræ*). On all three of these, on the central, or only on the lateral regions, are placed silicious denticles, whose number, form, and arrangement have been made the basis of classification. But their value is limited to the definition of genera. The gasteropods are divided into the following orders:—1. *Pteropoda*, which have an oar-like expansion on either side of the inconspicuous head. The microscopic *Clio*, hosts of which discolour the arctic seas, and furnish food to the whales, are the butterflies of the ocean, their triangular wings giving them a curious resemblance to insects, and *Pneumodermon*, which yields a beautiful purple fluid, are naked; the exquisite *Hyalæa* has a bubble-like shell, *Cuvieria* a cylindrical one, while the three-sided pyramidal shell of *Cleodora* is the nearest living representative of the *Theca* and four-sided *Conularia*, abundant in Palæozoic strata. The *Limacina* and its kindred have the shell spirally coiled, but they are sinistral, that is, the coil is from left to right, dextral coils being found in most other gasteropods. All these genera are oceanic in their habits.—Order 2. *Opisthobranchiata.* In this order the branchiæ or gills are, as a rule, behind the heart, the auricle of which is therefore posterior to the ventricle. The sexes are united in the same individual. The nudibranch molluscs, to which the Sea Lemons (*Doris*), *Æolis*, *Glaucus*, &c., belong, have the gills unprotected by a mantle, and their soft bodies are set with papules and other appendages of beautiful forms and often exquisite colouring. The bubble-shells (*Bulla*), umbrella-shells, sea-hare (*Aplysia*), &c., have the gills covered by the edge of the mantle or by a shell; hence they are termed *Tectibranchiate;* or, from the lateral position of the gills, *Pleurobranchiate;* while the nudibranchs are also called *Dorsibranchiate*, these organs being placed on the back.—Order 3. *Heteropoda*, or *Nucleobranchiata.* In this group the body is nearly symmetrical, and the appendages are of large size in proportion to the internal organs, which form a nucleus on the posterior part of the upper surface. The animal adheres to plants, and creeps along their surface by a small disk, which corresponds to the central part of the creeping organ of a snail. The expanded anterior fin is equivalent to the anterior portion of the foot, while the tail, which is also used as a swimming organ, corresponds to that part of the body of a whelk on which the operculum is carried. The nucleus, on the anterior aspect of which the gills are placed, is either naked, as in *Firola;* or covered with a delicate shell, as in *Carinaria* and *Atlanta.* These are, like the Pteropods, oceanic. The extinct *Bellerophon*, of Palæozoic strata, is referred to this order; its shell is much heavier than that of any living form.—Order 4. *Prosobranchiata*, or *Branchiogasteropoda.* This order, which includes the majority of marine and fresh-water genera, is illustrated by the Whelks (*Buccinidæ*), the Strombs or Wing-shells, the Cones, the Volutes, the Cowries, families in which the mouth of the shell is notched, or forms a canal for the passage of a syphon or funnel which conducts water to the gill chamber, the respiratory organs being inclosed in the mantle and protected by the spiral shell. These families are carnivorous, and form the section *Siphonostomata;* while the *Holostomata*, in which there is neither notch nor siphon, are chiefly vegetable feeders. They include the *Natica*, *Cerithium*, Turret-shells, Periwinkles, River-snails (*Paludina*), *Nerita*, Top-shells (*Turbo*), Ear-shells (*Haliotis*), Key-hole Limpets (*Fissurella*), Bonnet-limpets (*Calyptrea*), Limpets (*Patella*), and Chitons, the last family having a shell composed of several pieces succeeding each other along the back. The sexes are in distinct individuals, and the gills either form a circle around the body, as in the limpets, which are thus Cyclobranchiate; or a tuft on the back, as in the key-hole limpets. In the Pectinibranchiates a single gill occupies the cavity, as in the majority of the families above mentioned.—Order 5. *Pulmogasteropoda.* The air-breathing gasteropods have, in place of gills, a cavity of the mantle on the right or left side, according as the shell is dextral or sinistral. This chamber has a small outer orifice, which may be closed, while its thin wall allows the passage of air through to oxidate the blood which circulates in a vascular network, the canals often projecting on the surface. The terrestrial air-breathers, as the Snails and Slugs, either have a spiral shell or a small shelly plate embedded in the mantle, or are entirely unprotected: the sexes are united in the same individual. The aquatic air-breathers have an operculum by which the mouth of the shell is closed, the surface of the lung cavity is ciliated, and the sexes are distinct. This operculate group, to which *Cyclostoma* belongs, is closely related to the holostomatous section of branchiate gasteropods. The Gasteropoda are now often divided into the two groups: Isopleura (including the symmetrical Chitonidæ) and Anisopleura (including all the others). The Anisopleura are arranged in two orders, namely, Streptoneura, dicecious-shelled forms, with the visceral commissure twisted into a sort of figure-of-eight, and Euthyneura, hermaphrodite forms, with untwisted commissure. Of the above orders, 1, 2, 5 are euthyneurous, 3 and 4 being streptoneurous.

GASTON DE FOIX, Duke of Nemours, born 1489, son of John de Foix, count d'Estampes, and Mary of Orleans, sister of Louis XII., was the favourite of his royal uncle, who used to say with exultation, 'Gaston is my work; I have educated him, and formed him to the virtues which already excite admiration.' At the age of twenty-three he acquired great celebrity in the war which Louis carried on in Italy. He routed a Swiss army, rapidly crossed four rivers, drove the pope from Bologna, won the celebrated battle of Ravenna, April 11, 1512, and here

ended his short but glorious life, while attempting to cut off a body of retreating Spaniards.

GASTRIC FEVER See TYPHOID FEVER.

GASTRIC JUICE, the fluid secreted by the mucous membrane of the stomach, and on which the process of digestion chiefly depends. It is acid, and contains pepsin, its essential nitrogenous principle. The activity of the fluid has been ascribed to various acids, lactic, acetic, and butyric; but it appears that free hydrochloric acid is that which is secreted by the stomach, the others being the products of change of food undergoing digestion. The acid is necessary for the pepsin to exercise its properties, which are limited to the conversion of nitrogenous substances into *peptones*, fatty matters not being affected by it. The gastric juice is secreted in the tubular follicles, which are closely set in the mucous membrane: the walls of the deeper parts of the follicles are covered with granular oval cells, while the upper part of the tubes is covered with columnar epithelium, like that of ordinary mucous glands. The former have been regarded as the *peptic* cells, or those to which the digestive fluid is specially due. The properties of gastric juice have been artificially tested by placing a small bit of stomach in water at a temperature of 100° F. (37·7° C.) and introducing various substances: coagulated albumen is dissolved, and loses the power of recoagulating; gelatin is dissolved, and does not solidify on cooling. The power of gastric juice to coagulate casein is made use of in the manufacture of cheese, *rennet*, which is used in the process, being prepared from the mucous membrane of the calf's stomach. In cases of impaired digestion artificial pepsin has been used along with the food with benefit. It may be used alone or in combination with dilute hydrochloric (muriatic) acid; and in this form is taken with meals, or immediately after them. Gastric juice is a clear, colourless fluid, with a sour saline taste and peculiar sour odour. Its specific gravity varies from 1·001 to 1·01, and its reaction is acid. It consists of from 97·5 to 99·5 per cent of water, and from 0·5 to 2·5 per cent of solids. The solids consist of mineral substances, and of an organic substance, the chief active agent in digestion, namely, pepsin. The mineral substances are chiefly chlorides of sodium and potassium, also chlorides of ammonium and calcium, alkaline and earthy phosphates, and traces of iron. After ingestion of food, or by mechanical irritation, the gastric juice has always a strong acid reaction, and much has been said as to the nature and origin of the acid by different chemists and physiologists, all of whom have relied upon experiment. It was for a long time a question whether the acid reaction was or was not due to hydrochloric or to some organic acid. It now appears to be settled that the principal acid is really the hydrochloric, but that there are also usually present acetic, butyric, and lactic acids, though in considerably smaller quantity. The hydrochloric acid seems to belong essentially to the gastric secretion itself; but with regard to the others it is not quite decided whether they are formed in whole or in part during digestion, or are secreted by the stomach. The hydrochloric acid is *free* in the juice, and is present to the amount of ·2 per cent. It is of vital importance, as experiment has shown, in the process of gastric digestion, pepsin being inert in an alkaline medium and practically valueless without its associated acid. The acid reaction of the stomach fluid disappears after continuous fasting or after sleep, indeed the fluid is often alkaline from a covering of mucus, which is secreted by the mucous membrane of the stomach. Gastric juice is not possessed of any marked reactions with ordinary chemical reagents; it does not become turbid by boiling; it gives no striking precipitates with acids, alkalies, or mineral salts, but its most important character, its digestive power, is destroyed or curtailed both by heat and by a variety of mineral substances. See also the article PEPSIN.

GASTRIC SYSTEM comprehends all the parts of the body which contribute to digestion. *Gastric disorders* are those in which the digestion particularly is deranged. As the precepts of health, with regard to eating and drinking, are so often transgressed, the quality of the food itself often bad, the gastric system composed of many parts, and much affected by the influence of the external temperature, gastric disorders must necessarily be frequent. Their symptoms are want of appetite, a bitter and disagreeable taste, a furred tongue, frequent and unpleasant rising from the stomach, a sense of weight and oppression in the belly, looseness or costiveness, &c. From the close connection of the organs of digestion with the other parts of the body gastric disorders are often combined with others—for example, with fever. See DYSPEPSIA and DIGESTION.

GASTRITIS, or GASTRO-ENTERITIS. See ENTERITIS.

GASTROSTOMY, in surgery, the operation of making an opening into the stomach, through which food may be introduced in cases of obstruction or stricture of the gullet. It has not yet been successfully performed on the human subject.

GASTROTOMY, in surgery, the operation of cutting into the cavity of the abdomen in order to remove some foreign body or for some other purpose. It is also known as *laparotomy*.

GASTRULA, in embryology, that stage in the development of metazoic animals in which the embryo has the form of a two-layered sac enclosing a central cavity which communicates with the outside by means of an opening called a *blastopore*. The gastrula-stage follows the *blastula* or *morula* stage, in which the animal appears as a spherical embryo with a differentiated outer layer. It is developed from the blastula by a process of invagination, or unfolding of the *hypoblast*, or inner layer of the cavity referred to, over the inside of the *epiblast*, or outer layer. The cavity, known as an *archenterion*, is a primitive intestinal cavity, and the blastopore is a primitive mouth.

GATES, HORATIO, an American officer, who distinguished himself during the revolutionary war, was born at Maldon, Essex, in England, in 1728. He early embraced the career of arms, and rose to the rank of major by merit alone. At the capture of Martinique he was aide-de-camp to General Monkton, and after the Peace of Aix-la-Chapelle was for some time stationed at Halifax in Nova Scotia. He was again called into active life by the breaking out of a new war, and was with Braddock when that unfortunate commander was defeated in 1755. On the conclusion of peace he repaired to his native country. He soon, however, returned, and purchased an estate in Virginia, on which he resided until the commencement of the revolutionary war in 1775, when he was appointed adjutant-general by Congress, with the rank of brigadier. At the head of the American army of the north he came up with the British general Burgoyne, and after some protracted fighting obliged him to surrender his whole army (16th October, 1777). For this success, the greatest gained by the Americans during the war, it was proposed by many to elevate him to the supreme command instead of Washington. In June, 1780, Gates received the chief command of the southern districts. In this quarter the affairs of the colonies were in a very bad condition.

Charleston had been taken, and General Lincoln captured. When Gates assumed the command of the southern army it scarcely amounted to 1500 men, badly supplied in every respect. After collecting all the troops he could, and equipping them as well as he was able, he advanced against the enemy, whom he met, August 16, under Cornwallis, at Camden, where the Americans were totally defeated. About fifty days after this disaster General Greene was sent to supersede Gates, whose conduct was subjected to the investigation of a special court. After a long and tedious inquiry he was finally acquitted, and reinstated in his command in 1782; but in the interim the war had been brought to a termination by the capture of Cornwallis. When peace was made he retired to his Virginia estate, and in 1790 removed to New York, having first emancipated all his slaves, and provided for such of them as could not provide for themselves. He died in New York on April 10, 1806, in the seventy-eighth year of his age.

GATESHEAD, a parliamentary, municipal, and county borough and seaport of England, in the county of Durham, on the right or south bank of the Tyne, opposite to Newcastle, with which it is connected by three bridges. Of these, the High Level Bridge was built by Stephenson in 1849, and has six arches of iron supported on stone piers. A railway and a road both cross it, the latter below the former. A swing bridge of six spans replaces an older bridge washed away in 1776; and the remaining one is of iron, and dates from 1876. Despite considerable improvements executed in recent years, and some fine new streets and buildings in the suburbs, Gateshead is a very dingy, dismal place. Its principal buildings are the parish church, last restored in 1875; several other churches and chapels; the Abbot Memorial Industrial School; the town-hall, erected in 1870, in Italian style, with a statue of Queen Victoria; the Mechanics' Institution; high and various other schools; public baths and laundries; children's hospital; and King James's Hospital, originally established in the thirteenth century, though the present building belongs to the nineteenth. A free public library was inaugurated in 1886, and a public park of 50 acres was opened in 1874. The industrial establishments are very extensive, and include works where heavy articles in iron, such as girders, anchors, and chain-cables, as well as engines, &c., are made; ship-building yards, roperies, brass, copper, and iron foundries; paper, glue, vinegar, glass, artificial manure, and large chemical works. One of the largest of these establishments is the locomotive works of the North-Eastern Railway Company. In the vicinity are quarries from which the celebrated 'Newcastle grindstones' are obtained, and numerous collieries. The town sends one member to the House of Commons. It received a charter in 1164, and till 1695 was governed by a bailiff under the Bishop of Durham. Pop. in 1881, 65,803; in 1891, 85,692; in 1901, 109,891.

GATH (Hebrew, wine-press), one of the five cities of the Philistines which were presided over by so many princes or lords from the time of Joshua to a comparatively late period. It was situated on the borders of Judah, and was in consequence a place of much importance in the wars of the Jews and the Philistines. It is stated in Joshua that Gath was one of the cities in which, at the time of the conquest, there still remained some of the ancient Anakims or giants, and they appear to have perpetuated the race here till much later times, for it was from Gath that the renowned Goliath issued. The exact site of the ancient city cannot be determined with any degree of certainty. Some identify the site with the eminence Tell-es-Sâfieh, about midway between Ekron and Ashdod.

GÂTINAIS, or GASTINAIS, anciently a division of France, which in the eleventh century had counts of its own; it was afterwards joined to Anjou. Subsequently it belonged partly to the government of Orleans and partly to the government of the Isle of France, and was distinguished by the names of *Gâtinais Orléanais* and *Gâtinais Français*. It now forms part of the departments of Seine-et-Marne, Seine-et-Oise, and Loiret.

GATINEAU, a river of Canada, in the province of Quebec, rising in a large lake of the same name, from which it flows south, and falls into the Ottawa opposite the town of Ottawa. Its total length is 450 miles. Much timber is now floated down the Gatineau, which is navigable for the heaviest bateaux and other small vessels for 5 miles from the Ottawa, and for canoes upwards, it is said, of 300 miles. It is a large, wild, and rapid stream, abounding in the most romantic scenery. It is well stocked with fish, chiefly bass, pike, pickerel, cat-fish, sturgeon, eels, &c. The country through which it flows is only partially settled. A railway follows its right bank for some distance up from its mouth.

GATLING GUN. See MACHINE GUN.

GATSCHINA, a town of Russia in Europe, in the government of, and 28 miles S.S.W. of St. Petersburg, on a small lake formed by the Ishora. It is regularly built, and contains one of the finest of the imperial palaces of Russia, surrounded with extensive and well-laid-out gardens. There are here Greek churches, a Lutheran and a Roman Catholic chapel, and two hospitals, a school for the blind, and another for horticulture. In the town are a pottery and manufactories of woollen cloths and hats. Pop. 12,000.

GATTERER, JOHANN CHRISTOPH, a German writer, born at Lichtenau, in the territory of Nürnberg, in 1727, studied at Nürnberg and Altdorf, devoting himself particularly to historical science, obtained a place in the gymnasium at Nürnberg, went in 1758 as regular professor of history to Göttingen, and died there in 1799. He published several excellent manuals of diplomacy, chronology, genealogy, geography, and heraldry.

GATTINARA, a town of North Italy, on the right bank of the Sesia, 17 miles north-west of Novara, and in the province of that name. It is walled, entered by four gates, and built with great regularity in the form of a rectangle. Its only remarkable edifices are a parish church, on a magnificent scale, partly ancient and partly modern; and the remains of some feudal castles. Pop. 5000.

GAU, a German word, meaning in general district, tract of country, particularly flat or low-lying country, in opposition to mountain or town; but in a special sense a district as a political unit and its inhabitants as a political association. Such political divisions existed in Germany as early as the time of Tacitus. The state (*civitas*) formed the highest unit, the village (*vicus*) the lowest, and between these was a middle division called by Tacitus *pagus*, in German usually translated *Gau*. These *pagi* corresponded to the divisions which appear later among the German peoples (as in England in early times) under the name of hundreds. Though united together to form one state, they formed each an independent whole, with the management of their own military and judicial affairs. Accordingly, on the increase of population, or when anything happened to loosen the bond between the Gau and the rest of the state, the former might separate and form a civitas by itself. All the freemen of the Gau met at certain periods, under an elected head or president, to discuss and settle matters relating to the public weal, punish

crimes, &c.; and in the same way meetings were held of the head men of the Gauen, to settle matters relating to the state at large. In the Frankish Empire, which embraced all the German peoples proper, the Gau was not only retained, but was made the basis of the whole administrative system, but its character was now greatly altered. Each Gau now had as its head a royal officer called a graf or count. It is to the districts governed by these counts that the term Gau is most strictly applied. See COUNT.

GAUCHOS. See PAMPAS.

GAUDY, FRANZ BERNHARD HEINRICH WILHELM, FREIHERR VON, a German poet, born in 1800 at Frankfort-on-the-Oder, son of a Prussian military officer of Scottish descent. He commenced his studies at Paris, and completed them at Pforta; then entered the Prussian army, where he soon obtained promotion. As the military career had little charms for him he quitted it, and went to reside in Berlin, where he devoted himself to literature. A great part of his latter years he passed in Italy. He died at Berlin in 1840. His earlier productions are in the style of Heine; those of his maturer years, by the pungency of their wit, their felicity of expression, and their graceful, easy style, remind us strongly of Béranger, Among the more important of his works are: Erato (Glogau, 1829); Gedankensprünge eines der Cholera Entronnenen (1832); Desengaño, a novel; Kaiserlieder, songs consecrated to the glorification of Napoleon; and a number of novelettes and novels depicting German and Italian life. He edited, in conjunction with Chamisso, the Deutscher Musenalmanach, after Schwab had retired.

GAUGE, the name of many different instruments and appliances used for measuring various dimensions, forces, &c. The various kinds of gauge are distinguished by means of special names indicating the use to which they are applied. Among the most important contrivances of this nature are the instruments fixed to engine boilers for registering the force of the steam and the level of the water. In one of its simplest forms the pressure or steam gauge consists of a bent siphon-tube, with two unequal legs, partly filled with mercury. The top of the shorter limb is connected to a short pipe, which enters that part of the boiler which contains the steam; the other end is open to the atmosphere. A stop-cock is generally placed between the gauge and the boiler, so that it may be put in communication with the boiler at pleasure. When the stop-cock is open, the steam, acting on the mercury in one leg of the gauge, presses it down, and the mercury in the other leg rises. The difference between the two columns is the height of mercury which corresponds to the excess of the pressure of the steam in the boiler above the pressure of the atmosphere. For high-pressure engines, however, the steam-gauge usually works in the manner of an aneroid barometer, a pointer moving on a circular scale under the influence of the motion of a corrugated diaphragm; or, as in the Bourdon gauge, the tendency of a bent tube to straighten itself under the influence of the steam pressure communicates movement in a similar manner to a pointer or index hand. The water-gauge is a vertical glass tube called a *gauge-glass*, communicating above and below with the boiler. The gauge-glass is not fixed directly to the boiler, but to a brass column known as the *gauge-column*, communicating with the boiler by two copper tubes of considerable length. the upper leading to the steam space and the lower to the water space. These tubes are fitted with cocks or valves. Two gauge-glasses of different lengths are sometimes fitted to the one column. Gauge-cocks are used as checks on the water-gauges. There are usually three of them on the front of the boiler, one at the normal level of the water, one above, and one below. As applied to railways, gauge signifies the distance between the centres of each pair of rails, which in the ordinary or narrow gauge is 4 feet 8½ inches. (See RAILWAYS.) The wire-gauge is an oblong plate of steel with notches of different widths cut on the edge; these are numbered, and the size of the wire is determined by trying it in the different notches until one is found which it exactly fits. The thickness of sheet-metal is tried by a similar gauge. The Birmingham wire-gauge is the best-known instrument of this kind in Britain.

GAUL, GALLIA. The country of the Gauls extended, in the times of the Romans, from the Pyrenees to the Rhine, and on the side of Italy, beyond the Alps to the Adriatic. It was divided into Gaul on this side (the Italian side) of the Alps (Gallia Cisalpina), and Gaul beyond the Alps (Gallia Transalpina).

I. Gallia Cisalpina extended from the Alps to the Adriatic Sea, and consequently comprised all Upper Italy as far as the Rubicon and Macra. In consequence of its connection with Italy it assumed the Roman manners and customs, received the Roman citizenship from Cæsar, and, on account of its adoption of the Roman *toga*, was called *Gallia Togata*. It was divided into—1. Liguria, comprising the territory of Genoa and Lucca, with a part of Piedmont; 2. Gallia Transpadana, Gaul beyond the Padus (the Po); and 3. Gallia Cispadana, that is, Gaul on this side of the Po. Liguria was inhabited by the Ligurians, Gallia Transpadana principally by the Taurinians, Insubrians, and Cenomani; Gallia Cispadana by the Boii, Senones, and Lingones, all of them nations of Gallic descent. Most of the cities, which were principally Roman colonies, have retained their ancient names. In Gallia Transpadana were Tergeste (Trieste), Aquileia, Patavium (Padua), Vincentia (Vicenza), Verona, Mantua, Cremona, Brixia (Brescia), Mediolanum (Milan), Ticinum (Pavia), Augusta Taurinorum (Turin); in Gallia Cispadana, Ravenna, Bononia (Bologna) Mutina (Modena), Parma, Placentia (Piacenza).

II. Transalpine Gaul was also called *Gallia Comata* in distinction from *Gallia Togata*, because the inhabitants wore their hair (*coma*) long, or *Gallia Braccata*, because, particularly in the southern parts, they wore a peculiar kind of breeches (*braccæ*). It was bounded south by the Pyrenees and the Mediterranean, east by the Rhine, by a line drawn from it to the river Var, and by this river; west by the Atlantic, and north by the English Channel and North Sea; it thus comprised France, Belgium, and part of Holland, Switzerland, and part of Germany. The part of Transalpine Gaul nearest Italy, and stretching along the Mediterranean towards the Pyrenees, was conquered by Fabius, and was called by way of eminence the Province (*Provincia*; now Provence). It was bounded by the Alps, the Cevennes, and the Rhone. Cæsar, who conquered Transalpine Gaul at a later period, found it divided into three parts: 1. Aquitania, extending from the Pyrenees to the Garonne, chiefly occupied by Iberian tribes; 2. Gallia Celtica, from the Garonne to the Seine and Marne; 3. Gallia Belgica, in the north, extending to the Rhine. By the command of Augustus, Agrippa organized the country anew, and divided it in the following manner:—1. Aquitania was enlarged so as to reach the Loire, in order to render it more nearly equal to the others; capital, Burdigala (Bordeaux). 2. Belgica, between the rivers Seine, Saône, Rhone, Rhine, and the North Sea; capital places, Vesontio (Besançon), Augusta Trevirorum (Trèves), and others. This division included also the countries on the Rhine, and Switzer-

land, which were, however, afterwards separated from it, under the name of *Germania prima* or superior, and *Germania secunda* or inferior. In it were situated, along the Rhine, Colonia Agrippina (Cologne), Moguntiacum (Maintz), Argentoratum (Strasburg). 3. Gallia Lugdunensis, or Celtica, comprised the rest of the country of the Celtæ, the whole region between the Seine, Saône, and Loire, as far south as the Cevennes and the Rhone; chief towns, Lugdunum (Lyons), Alesia (Alise), Bibracte, afterwards called Augustodunum (Autun), Lutetia Parisiorum (Paris). The latter was, in the time of Cæsar, an insignificant place, confined to the island in the Seine; but it soon rose into importance on account of its favourable situation. 4. Gallia Narbonensis, formerly the Provincia Romana. Here were the cities Narbo Martius (Narbonne), an old Roman colony, Tolosa (Toulouse), Nemausus (Nismes), Vienna (Vienne), Massilia (Marseilles). The latter city was an ancient Greek colony.

The Gauls were the chief branch of the great original stock of Celts. On the whole, a great resemblance appears to have existed among all the Celts; and although they were divided into numerous tribes, there were but few branches that were perceptibly different from each other. It is probable that, coming from the East, they took their way along the south side of the Danube, having the numerous nation of the Thracians in their rear and the Germans on their side; but the period of this event is so remote that we cannot even venture a conjecture in regard to it. They took possession of several countries under different names in their earliest migrations: thus, under the names of Umbri and Ausones they occupied a part of Italy; of Taurisci (afterwards Rhætii), Vindelici, Norici, Helvetii, the Alpine countries. Several Celtic tribes retained their seats on the shores of the Adriatic, along the banks of the Danube, and in the southern part of Germany, while the principal branch of the nation settled between the Pyrenees and the Alps, the ocean and the Rhine, in the country which received its name from them; hence they passed into Albion and Ierne (Great Britain and Ireland).

A too great population (which is not uncommon in half savage and partly nomadic nations whose means of supplying their wants are very imperfect, and who require a great extent of country), and the pressure of German and Thracian tribes, caused general migrations among the Gauls about 397 B.C. Colonies from many tribes took their course over the Alps into Italy, and eastwards along the Danube. This passage of the Celtic Gauls over the Alps first brings that nation into the region of history. We find it divided into many tribes, one of them (at that time the Bituriges) with a superiority almost amounting to a supremacy. The abuse of this superiority caused dissensions, and individuals joined some other tribes. In this manner the superiority passed into different hands; but the general system remained the same. The system of dependence went through the whole nation. The only free men were in fact the nobles (who, by way of distinction, were called *warriors*) and the priests (*Druids*). The common people lived in a state of subjection, defended against wrongs and injuries, not by the laws, but by the protection of the powerful. Among the nobility the numerous princely families held the first rank. In important expeditions they seem to have chosen a general chief. (See BRENNUS.) The male and female Druids were in possession of certain knowledge, which they secretly taught in the depths of shady groves and dark caves. They were not ignorant of astronomy, the natural sciences, and poetry; but their religion was replete with abominable priestcraft, superstition, and cruelty, human beings being frequently sacrificed. Duels and drunkenness were common among the Gauls; cities few, villages numerous; their household utensils few and poor. Few of them tilled the ground, the greater part subsisted on the produce of their herds and flocks. Their beverage was a kind of beer or mead; the cultivation of the vine was unknown to them. The sand of the rivers and some mines furnished gold to the higher ranks. Persons of distinction went into battle with a cloak around their shoulders made of a party-coloured stuff or tartan. They wore no other garment: their neck and arms, however, were decorated with thick gold chains. Their high stature, savage features, and matted yellow hair, rendered their aspect terrible; their impetuous courage, their immense numbers, the stunning noise which proceeded from their numerous horns and trumpets, their terrible devastations whenever they passed through a country, rendered them the terror of the western world. But they were destitute of union, perseverance, and good arms; for their shields were light and badly contrived, and their enormous swords of copper were bent at every blow upon iron, so that it was frequently necessary to straighten them. For this reason their first onset only was to be feared. This nation—whether the love of wine, or the invitation of an Etruscan, whose wife had been seduced by one of the princes of the country, and who thirsted for revenge, had allured them into Italy—this nation fell upon the Etrusci, who in comparison with them were effeminate, and who were at the same time assailed by the Romans. On the very same day (396) on which Camillus conquered Veii the Gauls are said to have taken by assault Melpum, a considerable city of Upper Italy belonging to the Etrusci. But the tempest of this migration was soon directed against the city of Rome itself, which, foreseeing its own fate in the Etruscan cities that lay around it, endeavoured to stop the victorious course of the Gauls by entering into negotiations with them. On this occasion the Roman ambassadors violated the law of nations; the incensed Gauls being denied satisfaction advanced towards Rome, destroyed the flower of the Roman youth in an engagement on the small river Allia (390 B.C.), sacked and burned the city, and laid siege to the capitol, which was on the point of purchasing its deliverance with gold when Camillus appeared to rescue it.

Our accounts of the course of the eastern Gauls along the banks of the Danube are very imperfect; this, however, is evident, that their movements occasioned the migrations of whole nations. 109 years after the burning of Rome, the eastern Gauls, from 280–278 B.C., made three destructive irruptions into Macedonia and Greece, which had already been depopulated by former wars. Ptolemy Ceraunus, king of Macedonia, and Sosthenes, the commander of the army, fell in battle, and Greece trembled. But in an attack on the temple of Apollo at Delphi (which contained immense treasures, but was protected by its situation) the terrors of religion and the assaults of the elements (tempests and hail-storms) came over them; they were defeated, and hunger, cold, and the sword of the Greeks completed their destruction. Several tribes pursued their course into Asia Minor, where, under the name of *Galatians*, they long retained their national peculiarities, and preserved their language even to the latest period of the empire. The reaction of these migrations upon Gaul itself appears to have been considerable. The Gauls along the banks of the Danube and in the south of Germany disappear from that time. Tribes of German origin occupy the whole country as far the Rhine, and even beyond that river. The Belgæ, who were

partly German, occupied the northern part of Gaul, from the Seine and Marne to the British Channel and the Rhine, from whence colonists passed over into Britain, and settled on the coast districts. The Celtæ in Gaul, though retaining the chief features of those peculiar manners and customs which we have above described, attained a higher degree of cultivation, to which probably their intercourse with the Greeks in Massilia (Marseilles), whose letters they used in writing their own language, and with the Carthaginians, in whose armies they frequently served as mercenaries, contributed in a great measure. But they were then hardly able to resist the Germans who lived on the other bank of the Rhine. Their kinsmen, the Britons, who painted their bodies, fought from chariots, and practised polygamy, were more fierce than the Gauls.

Meanwhile the Gauls of Cisalpine Gaul had taken up their residence in the fertile plains of Upper Italy. Here they continued formidable to the Romans for a long time, sometimes in wars which they undertook on their own account, and at others as mercenaries in the service of other nations. But after the first Punic war had been successfully brought to a close, 172 years after the burning of Rome, the hour of revenge was come. The Gauls in vain called some warlike tribes of their brethren over the Alps to their aid. After a destructive war of six years the nation was compelled to submit to the Romans (220 B.C.) When Hannibal carried the terror of his arms to the gates of Rome, they attempted to shake off the yoke; but the Romans, victorious over the Carthaginians, reduced them again to submission. Thirty-one years later (189 B.C.) their kindred tribe in Asia, the Galatians, met with the same fate; they also were vanquished, and their princes (tetrarchs) became tributary. Deiotarus, in whose defence Cicero delivered an excellent oration, which we still possess, was one of these princes at a later period. The ambition of the Romans soon surmounted the Alps also. They had subjected Spain, and it was important to them to have a passage by land, by which they could easily march troops into that country. By the subjection of the Allobroges and Arverni, the latter of whom were at that time the principal nation in Gaul, the Romans, in the years 128–122 B.C., conquered the southern part of Gaul along the sea from the Alps to the Pyrenees. The descriptions of the Arverni and their kings show their splendour to have been considerable. They had stately courts, at which even poets were maintained. It is related that they kept dogs both for hunting and for war. Soon afterwards Europe was agitated, from the Black Sea to Spain, by the expeditions of the Teutones and Cimbri, the former certainly of German origin. They were joined by many tribes, particularly Gauls, and destroyed four consular armies. Rome trembled at the irruption of these barbarians into Italy; but Caius Marius (see MARIUS) saved the republic. In two bloody battles, at Aix (Aquæ Sextiæ) in 102, and at Vercelli in 101 B.C., he destroyed these nations. Only that portion of these nations which had remained in Gaul to await the issue of the expedition escaped the general ruin. Forty-three years after this event Caius Julius Cæsar received the proconsulship over the countries bordering on Gaul. He resolved to subject all Gaul, and executed his purpose in less than nine years (58–50 B.C.), in eight bloody campaigns. Cæsar found Gaul torn by internal dissensions and enfeebled by the attacks of the Germans, a body of whom, under their king Ariovistus (Ehrfest), had passed the Rhine. At first he assumed the character of a deliverer and protector of the Gauls, driving back the Helvetii—a Celtic people who were commencing an expedition against Gaul—into their own country, and compelling Ariovistus also to return to Germany. At a later period he subdued the fierce Belgæ, and repelled the incursions of several German tribes. But when the Gauls perceived that the Roman troops were continually maintained in their country, they became alarmed for their liberty, and rose against the Romans. More than once the Romans suffered heavy losses; but their superiority in the art of war, and the genius and fortune of Cæsar (after the sacrifice of 1,000,000 of Gauls), secured them the final victory. The last great leader of the Gauls, the valiant Vercingetorix, after having sustained one of the most remarkable sieges in the records of ancient times in the city of Alesia (now Alise, near Dijon), was compelled, in the year 52 B.C., to surrender to the Romans. Some later revolts proved fruitless. Cæsar completed the subjugation of Gaul, and by means of the money and troops of that country rendered himself absolute master of the whole Roman Empire. The dominion of the Romans in Gaul was confirmed by colonies, and the liberal grant of the Roman citizenship to several Gallic tribes. The religion of the Druids, being suppressed in Gaul by Tiberius and Claudius, gradually retreated into Britain, where, particularly on the small islands near the British coasts, the priests established their mysterious rites, of which in ancient times strange and dreadful accounts were current. The Britons also were soon conquered by the Romans. After the extinction of the family of the Cæsars, the Gauls once more made an attempt to recover their liberty by the aid of the Germans, but in vain. After this last effort they gradually became Roman citizens, and so entirely Romanized that even their ancient language, the Celtic, was supplanted by a corrupt Latin dialect, retaining, however, a considerable number of Celtic words, especially as roots, which, intermingled with Franco-Germanic words, formed the modern language. About the year 486 the Franks subdued the greater part of Gaul, and put a period to the dominion of the Romans in that country.

GAULT, the name locally given to a division of the upper cretaceous rocks in England. See GEOLOGY.

GAUNTLET, or GANTLET (dim. of French *gant*, a glove), a glove made originally of chain-mail, later of plate, and jointed at the fingers, used as part of the armour of a warrior in former times. A gauntlet used to be thrown down as the intimation of a challenge to an adversary, who accepted the challenge and showed his readiness to fight by taking it up. It was a former custom in England at the coronation of a sovereign for the hereditary champion of the king or queen to throw down a gauntlet in Westminster Hall and challenge all disputants of the crown.

GAUR, or GOUR, a ruined city in Hindustan, in the British district of Maldah, 60 miles north by west of Murshedabad. From 1212 to 1574 it was the capital of Bengal. It extended about 7 miles along the banks of the old Ganges, or, including suburban villages, about 15 miles, with a breadth of 2 to 3, and was a populous and flourishing city upwards of 2000 years ago. Its decay proceeded from a change in the course of the Ganges, which, about two centuries since, deserted its old channel close by the city, and took that which it now occupies. The principal ruins of this ancient capital are those of a magnificent mosque, 170 feet long by 130 feet broad, built of brick, and faced with a kind of black porphyry, two picturesque gates, and a large edifice faced with bricks of various colours. This edifice contains a noble apartment, about 36 feet square, and 40 to 50 feet in height. There are several other mosques in

tolerable preservation, and an obelisk or tower, of about 100 feet in height, with a stair inside. The numerous tanks and reservoirs, some of them very large, which supplied the ancient city with water, are now swarming with alligators, mosquitoes, and all sorts of vermin. Several villages now stand on the site of the city.

GAURS. See GUEBERS.

GAUSS, KARL FRIEDRICH, a German mathematician, born at Brunswick 30th April, 1777. He early displayed such remarkable capacity for mathematical calculation that (his parents being poor) the Duke of Brunswick took charge of his education. At the age of eighteen, while a student at Göttingen, he solved a problem (that of the division of the circle into seventeen equal parts) which had occupied geometers from the time of Euclid. In 1801 was published his Disquisitiones Arithmeticæ, treating of indeterminate analysis or transcendental arithmetic, and containing, in addition to many new and curious theorems, a demonstration of the famous theorem of Fermat, concerning triangular numbers. He calculated, by a new method, the orbit of the newly-discovered planet Ceres, and afterwards that of Pallas, for which he received from the French Institute in 1810 the medal founded by Lalande. In 1807 he became professor of mathematics and director of the observatory at Göttingen, a position which he held till his death. In 1821, being charged by the government of Hanover with the triangulation of that country and the measurement of an arc of the meridian, he rendered the most distant stations visible by means of the heliotrope, an instrument of his invention for reflecting solar light; and in connection with Wilhelm Ed. Weber he made valuable investigations concerning terrestrial magnetism. He was pronounced by Laplace to be the greatest mathematician in Europe. He died at Göttingen 23d February, 1855. Among the more celebrated of his works are Theoria Motus Corporum Cœlestium (Hamb. 1809); Intensitas Vis Magneticæ Terrestris (Gött. 1833); Dioptrische Untersuchungen (Gött. 1841); and Untersuchungen über Gegenstände der höheren Geodesie (Gött. 1844).

GAUT. See GHAUT.

GAUTIER, THÉOPHILE, a French poet and critic, born 31st Aug. 1811, at Tarbes (Hautes-Pyrénées). He commenced his education at the college of his native town, and finished it at Paris. He studied painting under Rioult for two years, but gave up definitely the brush for the pen, and published in 1830 a volume of poems remarkable for picturesque originality, while imbued with the spirit of the poets of the sixteenth century. For several years he worked away at general literary criticism, until he secured a reputation for himself by the eccentric and somewhat licentious novel Mademoiselle de Maupin. This work brought him under the notice of Balzac, who employed him for some time as his secretary. He was afterwards engaged as theatrical and art critic on the Revue de Paris, the Artiste, the Moniteur, and the Journal Officiel. Some of his most important works are the fruits of travels over almost the whole of Europe and a part of the East. Owing to his connection with the Journal Officiel his fortunes became linked in some measure with those of the Bonaparte family. He was appointed librarian to the Princess Mathilde, and received the princely sum of 20,000 francs for a poem on the birth of the prince imperial. In 1872 he was sent by the republican government on a literary mission to Italy. He died on the 22d Oct. of that year. Among the most interesting of his productions may be ranked his Voyages en Espagne, his Italia, Zigzags, and Constantinople, narrations of his travels; Jean et Jeannette, Le Roi Candaule, Le Capitaine Fracasse, &c., novels; and his Histoire de l'Art dramatique en France depuis vingt-cinq Ans; Les Beaux Arts en Europe, &c.

GAUZE, in commerce, a thin transparent stuff sometimes woven with silk, sometimes with silk and cotton combined. Gauzes are either plain or figured. The latter are worked with flowers of silver or gold, on a silk ground, and are chiefly imported from China. Gauzes of excellent quality are manufactured in several localities in this country.

GAVARNI, the *nom de plume* of SULPICE PAUL CHEVALIER, the celebrated French caricaturist, born at Paris in 1801. Originally a mechanical draughtsman, it was not until 1835 that he began his artistic career by preparing designs of costumes for the theatres and the journals of fashion. He established the periodical Les Gens du Monde; but in spite of the brilliant series of satirical lithographs which appeared in it, the journal was a financial failure, and the artist had to spend some time in the debtor's prison of Clichy. On his release he was employed upon the Charivari, the success of which periodical was due in a great part to his genius. With advancing years the tone of the artist's mind became more grave. From the Lorettes, Actrices and Bals Masqués, he passed on to the Enfants Terribles, Politique des Femmes, Maris Vengés, and such like. In all the designs and the legends attached to them there were manifest an acute observation, keen insight into human nature, and pungent genuine wit. In 1847 he was induced by the Duc de Montpensier to visit England, and true to his artistic proclivities, he located himself in St. Giles, London, a quarter which supplied him abundantly with the scenes he liked to depict: boxing matches, rat and terrier fights, the exploits of the pickpocket and the drunkard. The sketches he made were sent to L'Illustration, and created an immense sensation. He was afterwards intrusted with the designs for Eugene Sue's Wandering Jew, Balzac's Novels, and other popular works. In 1852 he received the ribbon of the Legion of Honour. Towards the end of his career he gave a good deal of his attention to aerostation. He died 23d November, 1866, at Auteuil.

GAVELKIND, an old English tenure, by which the land of the father is at his death equally divided among his sons, or in default of sons, to the daughters This custom also extends to the collateral line, for it has been resolved that when one brother dies without issue all the other brothers shall inherit from him. Gavelkind, before the Norman Conquest, was the general custom of the realm; it was then superseded by the feudal law of primogeniture, and only retained in Kent, because, according to tradition, the Kentish men surrounded William I. with a moving wood of boughs after the slaughter at Hastings, and received for that service a confirmation of their ancient rights. In Kent the lands have, in special instances, been disgavelled or deprived of their customary descendible quality by statute; but *primâ facie*, all land in that county is gavelkind.

GAVIAL (*Gavialis*), a crocodilian reptile of Asia and Africa, one of the largest, if not the very largest of its order, sometimes reaching the length of 25 feet. It is found chiefly in India, the river Ganges being particularly infested with it. It is a striking animal, the extraordinary length of its muzzle giving it a singular and grotesque aspect. The prolongation of the head varies considerably according to the age and sex of the individual. In the young gavial just hatched from the egg the head is short and blunt, and only attains its full development when the creature has reached adult age. The males can be distinguished from the females by the shape of the muzzle, which is much smaller at the extremity.

The full complement of teeth is about 120. The gavial of the Ganges (*G. Gangeticus*) is of a deep sea-green colour above, with numerous irregular brown spots, smallest and thickest about the jaws, and below pale yellowish white. Notwithstanding its large size and numerous teeth, it feeds on fishes and small prey; the narrowness and feebleness of the jaws do not enable it to seize large land animals like the wide and stronger jawed crocodile and alligator.

GAVOTTE, an air for a dance with two strains, each of four or eight bars, in $\frac{2}{4}$ or $\frac{4}{4}$ time, the starting notes occupying half a bar. The gavotte, which is of a brisk nature, was more popular on the stage than in private assemblies, and is now rarely performed. Like the minuet, it has been introduced into sonatas, suites, and so on, where it is more freely treated. The name is said to be derived from the Gavots, the inhabitants of the Gap, a mountainous district in France.

GAY, JOHN, an English poet, was born at or near Barnstaple in 1685, and, after an education at the free-school of that town, apprenticed to a silk-mercer in London. He showed such a dislike to trade that after a few years his indentures were cancelled by agreement, and he devoted himself to literature. In 1712 he accepted the office of secretary to Anne, Duchess of Monmouth, which left him at leisure to pay his court to the muses. In 1713 he published his Rural Sports, which he dedicated to Pope. This compliment introduced them to each other, and proved the foundation of a friendship which lasted for life. In 1714 his caricature of Ambrose Philips' pastoral poetry was published, under the title of the Shepherd's Week, and dedicated to Lord Bolingbroke, who, with the Tory party then in power, much befriended the poet. By their interest he was appointed secretary to the Earl of Clarendon in his embassy to the court of Hanover; but the death of the queen threw a cloud upon his prospects. His pleasant mock-heroic poem, entitled Trivia, or the Art of Walking the Streets of London, was published in 1715, and in that year also was acted his burlesque drama of What d'ye Call it? which was followed by a farce, in conjunction with Pope and Arbuthnot, called Three Hours after Marriage, which altogether failed. In 1720 he published his poems by subscription, by which he secured £1000, and a present of South Sea stock, from Secretary Craggs. In 1724 he produced his tragedy of the Captives; and some instances of court favour encouraged him to employ himself in his well-known Fables, written professedly for the instruction of the Duke of Cumberland, and published with a dedication to that prince in 1727. This performance exhibits great ease of narration, and much lively and natural painting. His Beggar's Opera, the notion of which seems to have been afforded by Swift, was first acted in 1728, at Lincoln's Inn Fields, having been previously refused at Drury Lane. Its chief purpose was to ridicule the Italian opera; but the spirit of the poet rendered it a unique performance, from the mixture of nature, pathos, burlesque, and satire which it contains. It ran for sixty-three successive nights, and transformed the actress who represented the heroine into a duchess, but so offended the persons in power, that the lord-chamberlain refused to license for performance a second part of it, entitled Polly. This resentment induced his friends and the party in opposition to come forward on its publication with so handsome a subscription that his profits amounted to £1200, whereas the Beggar's Opera had gained him only £800. The Duke and Duchess of Queensberry took him into their house and managed his pecuniary concerns. He was soon after seized with dejection of spirits, but enjoyed intervals of ease sufficient to enable him to compose his pastoral of Acis and Galatea, and the opera of Achilles. He died in 1732, and was interred in Westminster Abbey. His monument bears a flippant epitaph taken from one of his letters to Pope. Among his smaller pieces, his two ballads of Black-eyed Susan and 'Twas when the Seas were Roaring, are much admired.

GAYA, a town of Hindustan, in Bengal, 260 miles north-west of Calcutta. It consists of an old and a new town. The former occupies a rocky height, is inhabited chiefly by Brahmans, and being regarded as a place of great sanctity, is annually visited by pilgrims to the number of at least 100,000. The latter, called Sahibgunge, where the Europeans reside, is situated on a plain watered by the Phalgu, a tributary of the Ganges, and consists of spacious straight streets, generally lined with trees. There are no buildings particularly deserving of notice, but the place abounds with objects of Hindu worship, and almost every height in the vicinity is the subject of a legend. Pop. (1891), 80,383; (1901), 71,187.

GAY-LUSSAC, LOUIS JOSEPH, one of the most distinguished chemists of modern times, was born December 6, 1778, at St. Léonard, in Haute-Vienne. His father, Antoine Gay, assumed the name Lussac from a property near St. Léonard. Young Gay-Lussac was educated in the École polytechnique from 1797 to 1800, and afterwards in the École des Ponts et Chaussées, but preferring chemistry, he entered Berthollet's Laboratory. In 1802 he returned to the École polytechnique as demonstrator of chemistry, and in 1804 performed his two balloon ascents for scientific purposes, the first with Biot, the second by himself, an account of which appeared in the Journal de Physique. In 1806 he was elected to the Academy of Sciences. In 1808 he was appointed professor of physics at the Sorbonne, a post he held for twenty-four years, in 1809 professor of chemistry in the École polytechnique, and then succeeded Fourcroy as professor of general chemistry in the Jardin des Plantes. Other offices he held; he was member of the council for arts and manufactures; for saltpetre and gunpowder; assayer for the mint; for tobacco, for alcohol, and similar posts. He was several times deputy, and in 1839 was raised to the peerage. He died at Paris May 9, 1850. His scientific work may be divided into two sections:—1st, that which deals with practical applications and the methods he devised for the rapid and accurate estimation of commercial products by volumetric and other processes; 2d, that which deals with pure chemical and physical subjects. To the former belong his methods for valuing alkalies and alkaline carbonates, for estimating the amount of available chlorine in bleaching-powder, for the wet assay of silver alloys for coinage, and such like. Of the latter only a few of the more striking—such as had a decided influence on the progress of the science—can be mentioned, for the mere enumeration of the titles of his papers would stretch far beyond our limits. Perhaps the chief one of all is his discovery of the definite composition by volume of gaseous substances, and the simple relation existing between the volumes of the constituents and that of the compound. This was the most valuable addition to Dalton's definite composition by weight, and it was used by its discoverer as an important check upon ordinary quantitative determinations. Along with Thenard he very soon adopted Davy's theory of the constitution of acids; a theory which grew out of the investigation by Gay-Lussac and Davy respectively of the nature of iodine and chlorine, and to which the former had already unknowingly contributed by his discovery of hydriodic acid, and especially of cyanogen. He also took an active part in the discussion on the consti-

tution of salts, which was intimately connected with the theory. His single investigations are very numerous, such as his analysis of air and of water; experiments with the great galvanic battery provided by Napoleon's orders; decomposition of the alkalies and preparation of potassium; the separation of the element *boron*, the investigation of the oxides of nitrogen and of sulphur. To organic chemistry he contributed many discoveries; along with Thenard he introduced great improvements in the way of determining the amount of carbon and hydrogen in an organic substance, and analyzed eighteen or twenty different bodies; he instituted experiments on fermentation, on etherification, and proposed a classification of organic bodies, based on the proportion of hydrogen and oxygen contained in them; he made an examination of many separate bodies, such as racemic, fulminic, and sulphovinic acids, alcohol and its relations, ether, and olefiant gas; but the most important is that of prussic acid, in which he succeeded in separating cyanogen, a body not only interesting for its own characters, but also because it was the first compound radical which had ever been isolated. Gay-Lussac's researches appeared in the Memoires de la Société d'Arcueil, of which he was a member, in the Journal de Physique, and latterly in the Annales de Chimie et de Physique, of which for thirty years he was the chief editor. Other works of his appeared separately, especially the Recherches Physico-Chimiques, made along with Thenard; A Course of Chemistry and a Course of Physics, both of which were published in 1828. Whether one considers the remarkable manipulative dexterity, precision, and success of his experiments, the clearness and originality of his views, and his candour in recognizing those more accurate than his own, the value of his discoveries, and the great number of them, one is quite willing to admit the truth of the verdict which was passed on him by a contemporary—Sir Humphry Davy—'I should place him at the head of the living chemists of France.'

GAY-LUSSITE, or NATROCALCITE ($Na_2CO_3,CaCO_3$ $5\,H_2O$), hydrated calcic and sodic carbonate, discovered by Boussingault in the soda lake at Maracaibo in Venezuela, South America, and named after Gay-Lussac. It crystallizes in oblique rhombic prisms, and is found in the clay at the bottom of the lake; it has a yellowish white colour, vitreous lustre, and is translucent and doubly refractive. It is brittle, and the fracture is conchoidal. Specific gravity, 1·92 to 1·99. When heated it decrepitates, fuses, loses carbonic acid gas, becomes opaque, and acquires an alkaline reaction. It is slightly soluble in water, and dissolves readily in acids.

GAZA, an ancient town, Syria, capital of the district of the same name, pashalic of Damascus, right bank, and about 3 miles from the mouth of the river Gaza, 50 miles S.S.W. of Jerusalem, on the high road between Egypt and Damascus. It stands upon a tabular hill, and is surrounded by fruit gardens hedged with prickly-pears, amidst which, on the lower ground, east and south-east, are two villages or suburbs. The eminence on which the town stands is about 2 miles in circumference at the base, and seems to have been once wholly inclosed by walls. Its elevated position, with its numerous domes and minarets, interspersed with olive and date trees, give it a pleasing and picturesque appearance. The bazaar and markets are of considerable importance. Gaza is a depôt for barley, and has many potteries. There are Protestant and Roman Catholic missions. Gaza is celebrated in Scripture for the exploit recorded of Samson, who carried away the gate of the city and its two posts.—The district of Gaza occupies the south-west corner of Syria, having the Mediterranean on the west, the valley of the Jordan and of the Dead Sea on the east, and Arabia Petræa on the south. The population of the town is estimated at 15,000.

GAZA, THEODORE, a successor of Emanuel Chrysoloras as teacher of the Greek language and literature in the West. He came a fugitive, after the capture of Thessalonica, through Turkey to Italy, and there speedily acquired a thorough knowledge of the language of the country. In 1440 he was public teacher at Ferrara, and in 1451 Pope Nicolas V. invited him, with other learned men, to Rome, where Cardinal Bessarion took him into his suite. After the death of Nicolas, King Alfonso invited him to Naples. When death had deprived him of this patron also he returned again to Rome. Here, however, he was so mortified by the smallness of a reward given him by Pope Sixtus IV. for a dedication, that he withdrew to Ferrara, and from that place to Calabria, where he died in 1478. Gaza laboured for the diffusion of Greek literature, not only by teaching, but also by his writings, and especially by Latin translations of the Greek classics. His chief work is a translation of the writings of Aristotle on natural history.

GAZELLE, the type of a group of the antelope family, of beautiful form, small size, and great swiftness of foot. Its colour is a light fawn upon the back, deepening into dark-brown in a wide band which edges the flanks and forms a line of demarkation between the yellow-brown of the upper portions of the body and the pure white of the abdomen. The face is rather curiously marked with two stripes of contrasting colours—one a black-brown line that passes from the eye to the curves of the mouth, and the other a white streak that begins at the horns and extends as far as the muzzle. The hinder quarters, too, are marked with white, which is very perceptible when the animal is walking directly from the spectator. The eye of the gazelle is large, soft, and lustrous, and has been long employed by eastern poets as the most flattering comparison to that of a woman. Both sexes are provided with horns, round, black, and lyrated, about 13 inches long. The horns of the female are pointed inward; the mammæ are two. The *Gazella dorcas* seems to be confined to the north side of the Atlas Mountains, Egypt, Abyssinia, Syria, Arabia, and South Persia. They feed generally at dawn and at evening, and approach water only once in twenty-four hours. They are hunted in various ways, and their flesh is excellent. In size it is a little less than the roebuck. The *kevel* is considered by some a mere variety of the gazelle; it is about the same size, but the head is longer, the horns more robust and longer, the eyes fuller; it is found to the south of the Atlas. The habits and general disposition of the colours are the same as in the gazelle. The *corinna* of Central Africa, described by Adanson, appears to be one or other of the above species. Other gazelles are the *m'hor* of Bennett and the *mangueer* of F. Cuvier, and the delicate creature *G. Sömmeringii*, an inhabitant of the north-east of Africa. (See plate at UNGULATA.)

GAZETTE. *Gazzetta* was the name of a small coin once in use at Venice, and also of a kind of primitive newspaper, published there and sold for that sum. *Gazzetta*, Spanish *Gazeta*, French *Gazette*, are still used for a newspaper, but the term in England is confined to that paper of news published by authority of the government. The first Gazette in England was published at Oxford, November 7, 1665. From that period the Gazette has appeared regularly twice a week, and besides the notifications published by court and government, contains those required by law in private transactions. See NEWSPAPERS.

GAZETTEER, a geographical dictionary. The first work of this kind with which we are acquainted is that of Stephen of Byzantium, who lived in the beginning of the sixth century. We have only an abridgment of it. The first modern work of the kind is the Dictionarium Historico-Geographicum (Geneva, 1565), by Charles Stephens, with additions by N. Lloyd (Oxford, 1670, and London, 1686). The works of Ferrari (Lexicon Geographicum, 1627) and Baudrand (Geographia Ordine Literarum Disposita, 1682) are full of the strangest errors. Those of Maty (1701), Thomas Corneille (three vols. folio, 1708), and Savonarola (1713) were based on the former, with additions and corrections. The Dictionnaire Géographique, Historique et Critique, of La Martinière (Hague and Amsterdam, 1726, ten vols. folio; Paris, 1768, six vols.) superseded all that had gone before it, though it retained many errors. The Geographisch-Statistisches Handworterbuch of the eminent German geographer Hassel (1817, two vols., with a supplement of two vols.) was the result of laborious and judicious investigations. The Universal Gazetteer, by Cruttwell (London, 1808, four vols. 4to), and the Edinburgh Gazetteer (six vols. 8vo, 1817–1822), once the principal English works of the kind, were in course of years superseded by several others, among which, as most entitled to notice, we mention Macculloch's Geographical Dictionary, Blackie's Imperial Gazetteer, Lippincott's Pronouncing Gazetteer (based upon Blackie's), and Longmans' Gazetteer of the World. The most valuable among the foreign gazetteers are the French Dictionnaire Géographique Universel, Saint Martin's Nouveau Dictionnaire de Géographie Universelle, and Ritter's Geographisch-Statistisches Lexikon. There are also gazetteers confined to particular countries, as Cassell's and Bartholomew's for the United Kingdom; Wilson's for England and Wales; Groome's for Scotland; De Colange for the United States; Raffelsperger for Austria; Joanne for France; Madoz, and of more recent date Del Castillo, for Spain; Hunter for India; &c.

GAZOGENE, an apparatus used for manufacturing aerated water on a small scale for domestic use. The aerated water is produced by the combination of an alkaline carbonate and an acid, which yield carbonic acid. The gazogene usually consists of two connected globes, one above the other, the lower for containing water, and the upper the ingredients for producing the gas. The vessel is made air-tight by means of a screw-top, and when water is gently introduced into the upper globe from the lower, by inclining the vessel so as to partly fill the former, chemical action takes place, and the carbonic acid evolved gradually saturates the water in the lower globe. When this has taken place the aerated water can be drawn off by opening a stop-cock at the top attached to a tube which reaches almost to the bottom of the lower globe.

GEBER, Abou Mousa Jabir, or Jabir Ben Haijan Ben Abdallah el-Sufi el-Tarsusi el-Kufi, is of all the Arabic chemists or alchemists the best known in Europe. His writings are believed to contain all the chemistry that was known in his time. He controverts the arguments of those who object to the theory and practice of transmutation; he points out the precautions necessary for success in the process; gives methods for purifying and preparing salts and other compounds to be employed; describes with remarkable minuteness and accuracy various kinds of furnaces and other apparatus, and cupellation, distillation, and other chemical processes; and devotes chapters to the purification, composition, and properties of the metals then known,—gold, silver, copper, lead, tin, and iron; and enters minutely into the functions of mercury, sulphur, and arsenic. He was acquainted with the mild and the caustic alkalies, with sulphuric, nitric, nitro-muriatic, and acetic acids, and with the salts obtained with these acids. With regard to the author himself it is very difficult to obtain reliable information. By Leo Africanus he was described as a Greek who had apostatized to Mohammedanism; by Antonius, as a native of Spain, and so on; but the account given in the Fihrist is that he was born at Tarsus, was a scholar of Jaafar ess-Sadik, whose works he collected, condensed, and edited, and died A.D. 776–777. But many difficulties and contradictions exist in the different accounts, and it is not easy ascertaining the value of the authorities. Geber is the reputed author of an immense number of works, as well on metaphysics, language, astronomy, &c., as on chemistry. Manuscripts in Arabic of his chemical writings are preserved at Rome, Leyden, and Paris; in Latin, and in English and other modern languages, at Oxford and elsewhere. The published writings of Geber fill a small volume, of which there is a very remarkable number of editions, and they are also contained in several of the collections of alchemical tracts. An edition appeared at Rome prior to 1520, at Strasburg in 1528, at Venice 1542, at Basel 1572, at Strasburg 1598, at Leyden 1668, and the commonest at Dantzig 1682. Translations have also been published in German and in French. In English there are two translations, one by Richard Russell (London, 1678, and with a new title-page, London, 1686); the other by William Salmon, in the collection of chemical writers appended to his Medicina Practica (London, 1692). Besides these there are various commentaries, which in some cases stand in much greater need of explanation than the text they are meant to simplify.

GEBERS. See Guebers.

GEBIRGE, a German word, the collective noun of *Berg* (mountain), signifying a chain or group of mountains, appears in many geographical names, as *Riesengebirge* (giant mountains), *Erzgebirge* (ore mountains), &c.

GECKO, a name applied to each of the species of a group of lizards constituting the family Geckonidæ of the order of reptiles Squamata. There are nearly three hundred species found in the warmer regions of the earth's surface. Almost all are nocturnal in their habits, and are of rather small size. A peculiar acrid mucus is secreted by glands on the under surface of the toes, which is said to possess a slight blistering property when applied to the skin, and to be otherwise poisonous. There is, in reality, little foundation for the fears which are entertained of this little reptile, whose chief occupation is hunting flies, mosquitoes, and other troublesome insects, which constitute its proper food. The ends of the toes are usually flattened into disc-like bodies, by means of which the animal is enabled to exhaust the air under the foot, and thus adhere forcibly to any flat surface on which it may be placed. In this manner it courses over perpendicular walls, and walks in perfect safety inverted on a ceiling. The pupil of the eye is very large, dilating and contracting in the same manner as those of the feline race among quadrupeds. The teeth are extremely small, and close set in the jaws. On the inferior surface of the thighs of some species are ranges of pores, and the skin of all the species is covered with rough scales and tubercles. *Platydactylus mauritanicus*, the common species of the south of France, &c., is of a deep-gray colour; the head rough; the body covered with tubercles arranged in clusters; scales under the tail similar

to those underneath the belly. During the day it lies hid in damp and obscure places, sallying forth in the evening to prey upon insects, which it pursues with great rapidity, uttering from time to time a short, sharp chirp. In Italy the gecko is called *terrentola*, in Provence *tarente*, and by the Romans it was called *stellio*. The gecko of the Levant and Egypt, *Ptyodactylus lobatus*, is smooth, reddish-gray, dotted with brown; scales and tuberoles very small. At Cairo this animal is generally seen crawling over walls and ceilings at dusk, and during the day lies hid behind furniture, and in dark, retired places. The natives call it *abou burs* (father of leprosy). Among other species are the fringed gecko (*Ptychozoum homalocephalum*), the Turkish gecko (*Hemidactylus turcicus*), the chick-chack (*Ptyodactylus gecko*) &c. See plate at REPTILIA.

GED, WILLIAM, inventor of stereotyping, was born at Edinburgh in 1690. He worked as a goldsmith and jeweller, and in 1725 took out a patent for his method of stereotyping, which was for long the only one in use. He met with such opposition in Edinburgh that he went to London, but there too he could not get his invention adopted. In 1731 the Earl of Macclesfield obtained a contract for him to print Bibles and prayer-books for the University of Cambridge, but only two prayer-books had been executed when the lease was surrendered. In 1733 he was again in Scotland, but his efforts to get his invention into operation proved scarcely more successful, and he died in poverty on Oct. 19, 1749. He stereotyped an edition of Sallust in 1744.

GEDDES, ALEXANDER, a Roman Catholic divine, of some note as a scholar, a poet, and miscellaneous writer, was born in the county of Banff, Scotland, in 1737. At the age of twenty-one he was sent to the Scottish College at Paris, and, returning to Scotland in 1764, officiated as priest among the Catholics in Angus. In 1765 he was invited by the Earl of Traquair to take up his residence at Traquair House, where he remained for more than a year, and then paid another visit to Paris. Returning to Scotland in 1769 he took charge of a Roman Catholic congregation at Auchinhalrig in Banffshire. In 1779 he was suspended from the performance of his functions by his bishop, on account of the liberality of his views and conduct, and more particularly because he attended the parish church of Cullen on various occasions, the minister being his intimate friend. In 1779 the University of Aberdeen granted him the degree of LL.D. He was the first Catholic since the Reformation to whom it had been assigned. In the beginning of the next year he repaired to London with a view of obtaining facilities for his scheme of a new English translation of the Old and New Testaments, and under the patronage of Lord Petre, who allowed him £200 a year, and provided him with the necessary authorities, he applied himself to this task. The first volume of his translation was published in 1792, the second in 1797. In consequence of the rationalistic views of Dr. Geddes in regard to the inspiration of the Scriptures and the divine mission of Moses, his work met with much censure, and his own immediate superiors suspended him. He was engaged on a translation of the Psalms when he died, in 1802, after a very painful illness. This learned but eccentric divine wrote many tracts, of more or less power, in vindication of his peculiar notions and opinions, as well as some original poems and poetical translations. See Good's Life of Geddes (London, 1803).

GEDDES, ANDREW, painter, was born at Edinburgh on April 5, 1783. Educated at the high school and university of his native city, he obtained a post in the excise office in 1803. His taste for art, however, led him to enter the schools of the Royal Academy in London in 1806, in which year he exhibited a picture of St. John in the Wilderness. He soon afterwards established himself as a portrait-painter in Edinburgh, and in 1814 he visited Paris to study the pictures in the Louvre. He afterwards settled in London, and in 1832 was elected A.R.A. He died in London on May 5, 1844. His best work is considered to be his portrait of his mother, of which he also prepared an etching; and his other works include many portraits, among them Sir David Wilkie and Dr. Thomas Chalmers, besides Discovery of the Regalia of Scotland in 1818; Christ and the Woman of Samaria; Devotion; Draught-Players; &c. He was also eminent as an etcher.

GEDGE'S METAL, or AICH'S METAL, an alloy containing 60 parts of copper, 38·2 of zinc, and 1·8 of iron. It is malleable at a red-heat, can be rolled, drawn, or cast, and has been used for cannon.

GEEL. See GHEEL.

GEELONG, a town of Australia, in the colony of Victoria, on Corio Bay, an extensive arm of Port Phillip Bay, 45 miles south-west of Melbourne by rail. The town is well laid out on ground sloping to the bay, and to the Barwon river on the south, and its streets abound with fine shops, business premises, and public buildings. The chief buildings are the town-hall, the post-office, the hospital, free library, mechanics' institute, the Gordon Technical College, various churches (including a synagogue), Geelong College, many schools, orphan and other asylums, a convent, besides the buildings containing the supreme court, customs-house, police-offices, &c. There is an extensive and well-laid-out botanical garden, besides public parks. There are four large jetties in the bay, and two channels have been cut through the bar to admit the largest ocean steamers. There are wool-mills, tanneries, paper-mills, rope-works, cement-works, and meat-preserving establishments, and a considerable trade is done in wool. The country surrounding Geelong is taken up by farms and orchards. The vineyards, formerly numerous, were destroyed owing to the ravages of phylloxera, but replanting is proceeding. Limestone is quarried near the town. Corio Bay is a favourite bathing resort. Pop. in 1901, 23,311.

GEESTEMÜNDE, a seaport town of North Prussia, in Hanover, at the mouth of the Weser, separated from Bremerhaven by the Geeste. Among the chief buildings are the town-hall (erected 1892), school of navigation, workhouse, hospital, &c. It has extensive docks, basins, and warehouses, with iron-foundries, ship-yards, machine-shops, biscuit-bakeries, rope and sail works, &c.; and is protected by formidable defensive works, which also serve to protect Bremerhaven. Ships of too deep a draught to ascend the Weser to Bremen load and discharge here and at Bremerhaven. Pop. (1900), 20,116.

GEEZ. See ETHIOPIA.

GEFLE, a seaport of Sweden, capital of län, and at the mouth of a river of same name in the Gulf of Bothnia. It stands on both sides of the river and two islands formed by it, consists of spacious and well-paved streets, and houses partly of wood and partly of stone; and has an old castle, an elegant town-house, a gymnasium, navigation and other schools; manufactures of linen, leather, tobacco, sail-cloth, &c.; shipbuilding-yards, and an excellent harbour; and a good trade in deals, tar, pitch, bar-iron, and salmon. Pop. (1897), 26,400.—The län, area 7614 square miles, has a coast deeply indented by bays, and an interior partly mountainous and covered with pine forests, and containing a large number of lakes, which, with the streams between them, form a kind of continuous net-work. The rearing of cattle is the

chief employment. The most valuable mineral is iron. Pop. (1897), 228,862.

GEHENNA. See TOPHET.

GEHLEN, ADOLPH FERDINAND, son of an apothecary, was born September 15, 1775 (1774), at Bütow, in Pomerania. He studied as an apothecary, and graduated in medicine at Königsberg; he then went to Berlin, worked under Klaproth and V. Rose, and afterwards taught chemistry at Hallé in the Reil Institute. In 1807, after election to the Academy of Sciences in Munich, he went to that place, where he died July 15, 1815, after nine days of terrible suffering, from having accidentally inhaled a small quantity of arseniuretted hydrogen gas. He published a large number of researches on chemical subjects, translated Berthollet's Art of Dyeing and Berzelius' Mineral System into German, and was the editor of several of the older chemical journals and annuals between 1803 and 1810, and the Repertorium für Pharmacie in 1815, since known as Büchner's.

GEHLENITE (after the chemist Gehlen), a mineral found in the Tyrol, which crystallizes in blackish or greenish gray-coloured prisms, which have a specific gravity of from 2·9 to 3·03, resinous lustre, and are brittle. It is a hydrated silicate of aluminium, calcium, and iron, and belongs to the mineral species called *Wernerites;* it is readily decomposed by acids with separation of gelatinous silica, but fuses only with difficulty.

GEHLER, JOHN SAMUEL TRAUGOTT, a German mathematician, was born at Görlitz November 1, 1751, where his father was burgomaster. He was educated in the gymnasium there, and studied natural science and mathematics, and afterwards law at Leipzig. In 1774 he delivered private lectures on mathematics; in 1777 he received a doctorate of law; in 1783 he was made a councillor at Leipzig, and in 1786 a member of the supreme court. He died October 16, 1795. The Physikalisches Wörterbuch (Dictionary of Natural Philosophy), a work which is a model in its kind (1787–95, five vols.), bears Gehler's name. Of this dictionary Brandes, Gmelin, Pfaff, Horner, and Muncke (under the superintendence of the latter, 1825–45) published a new edition. It is a work of uncommon excellence.

GEIJER, ERIK GUSTAV, the most eminent of modern Swedish historians, born in 1783 at Ransäter, in Wärmeland, received his first education at the gymnasium of Karlstad, and afterwards studied at the University of Upsal, where he was still a student when he gained the great prize of the Swedish Academy for a eulogy on the regent Sten Sture. After making a tour in Great Britain in 1809 he was first appointed lecturer, and in 1817 professor of history in the University of Upsal; in 1822, historiographer; in 1824, member; and at last president of the Academy. He was twice proposed for bishop, but the nomination did not take effect. At the diets of 1828–30 and 1840–41 he was deputy from the university, and was on both occasions placed on the constitutional committee. He died in 1847. He acquired considerable reputation as a poet by several very original pieces, which are contained in his Skaldestycken. His lectures to the students were remarkably popular, and distinguished by nervousness, perspicuity, and intellectual grasp. The fruits of his historical labours (mainly on the history of his native country) were given to the public in a variety of works, several of which have been translated into German. He also wrote several tracts on philosophy, theology, belles-lettres, and politics, and possessed great skill as a musical composer. Several of his pieces for the voice and piano are very much admired. His merits as a poet, historian, and composer are universally acknowledged; but opinions are divided as to the place which he ought to hold in respect of his political, theological, and philosophical writings, which have been published in a collected form in his Valda Smärre Skrifter.

GELA, one of the most important ancient Greek cities of Sicily, situated on the south coast of the island between Agrigentum and Camarina, and at the mouth of the river of the same name. It was founded in 690 B.C. by a colony of Cretans and Rhodians. The colony was remarkably prosperous, and in 582 B.C. sent out a portion of its inhabitants, who founded Agrigentum. The new colony soon outstripped its parent city, which, however, regained its supremacy under Hippocrates, brother and successor of Cleander, who had raised himself to sovereign power. The successor of Hippocrates, Gelon, followed a fortunate career of aggrandizement, and succeeded in making himself master of Syracuse itself (485 B.C.) This, however, was the cause of the decline of Gela, as the conqueror compelled half of its inhabitants to migrate to Syracuse, his new capital. His successor, Hieron, appears also to have driven a large number of Geloans into exile; but on the expulsion of Thrasybulus (466 B.C.) all these returned to their native city. The sixty years which followed seem to have been a period of great prosperity. In the spring of 405 B.C. the Carthaginians appeared before the city, which, though unfortified, made a protracted resistance. It was, however, taken, plundered, and laid waste. Gela never recovered its former prosperity, although it was still of some considerable political importance, until about 280 B.C., when Phintias, the tyrant of Agrigentum, removed the inhabitants to a town in the neighbourhood, which he called after his own name. The walls and houses of the older city were demolished, and it never recovered from the blow. The site of the city has been the subject of much controversy in modern times. It is now generally believed to be occupied by the seaport of Terranova (which see), at the mouth of the river still known as the Gela.

GELASIUS.—1. A bishop of Cæsarea and nephew of Cyril of Jerusalem, who flourished about A.D. 367, and at the request of his uncle, to whom he was indebted for his see, wrote a continuation of the history of Eusebius. Among his other works was an exposition of the creed.—2. The name of two popes—GELASIUS I. and II. The former, who held the see from 492–496, founding on the alleged primacy of Peter, was one of the first who openly maintained that the Roman bishop alone was entitled to regulate matters of faith and discipline, though in practice he had not then attained any such superiority. His work entitled Decretum de Libris Recipiendis et non Recipiendis is remarkable in the history of theology as showing the high importance which then began to be attached to the fathers on questions of orthodoxy. He also wrote a treatise, De duabus in Christo Naturis, against Eutyches and Nestorius. GELASIUS II., pope for only one year (1118–19), and originally called John of Gaeta, was elected by the party hostile to Henry V., but was obliged to give way to Gregory VIII., supported by the emperor, and shortly after died in the monastery of Clugny.

GELATIN. When different parts of animals, such as the skin, connective tissue, ossified cartilage, bones, hartshorn, calf's feet, sturgeon's bladder, fish-scales, are boiled for a long time with water, the fat and other impurities removed, and the concentrated solution cooled, it sets into a bulky jelly, consisting mainly of gelatin, the consistence of which depends on the degree of concentration. It has been much disputed whether gelatin exists as such in the tissues, or whether it is formed by boiling with water; but there are several considerations in support of the

former view. Thus the composition of bone cartilage and the gelatin it yields is the same, although of course there is the possibility that the body may pass by long boiling from one state to another without change of composition. Gelatin, though it cannot be extracted by cold water, dissolves in acetic acid; further, the tissue gives the same reactions as gelatin itself—for instance, with tannic acid; and a body identical with gelatin has been found in the blood in certain diseases. Pure gelatin is a brittle, pale-yellow, translucent or transparent, tasteless, odourless solid, which swells up in cold and dissolves completely in hot water, giving a fluid which, on cooling, solidifies to a jelly. The gelatinizing takes place even though the solution be very dilute. It is insoluble in alcohol and ether, and is especially distinguished by giving no precipitate with any of the common acids, but by forming a bulky insoluble compound with tannin, and also with chlorine water and corrosive sublimate. Other metallic salts which generally render animal substances insoluble do not affect gelatin solutions. Gelatin obtained from different sources has practically the same composition. That from bones contains—carbon, 50·4; hydrogen, 7·1; nitrogen, 18·1; oxygen and sulphur, 24·3, the sulphur amounting to rather more than a half per cent. The formula of gelatin is unknown. When acted on by various agents it yields leucin and the other decomposition products of the albuminates. How gelatin is formed, and what function it discharges, are equally unknown. It was formerly highly praised as a nutritious diet, and large quantities of it in the form of soup were consumed, especially in France, in hospitals and in poor-houses; but its value in this respect has been much disputed, and its nutritious properties have indeed been altogether denied. Gelatin, however, in the form of so-called calf's-foot jelly, is still used by invalids, and is regularly consumed by the wealthier classes. For these purposes it is manufactured from skins, bones, &c., on a very considerable scale by various processes, the essence of which consists in cleaning the materials, boiling them (sometimes under pressure), and clarifying and deodorizing the product as far as possible. It is then run into bottles or jars, and when it is required is melted by immersion in hot water. Another form is in cakes, which are obtained by drying the gelatin in the air, and finally in a stove. This operation requires great attention and care. Gelatin is not only consumed as an article of diet, but is extensively employed in photography and other arts. In a less pure form it constitutes glue (which see), and when obtained from the sturgeon's bladder isinglass (which see). For *blasting gelatine* see NITROGLYCERINE.

GELDERLAND, a central province, Netherlands, bounded on the N.W. by the Zuider Zee, on the N.E. by Overijssel, on the E. by Prussia, on the S. by Limburg and North Brabant, and on the W. by Holland and Utrecht; length, east to west, 88 miles; breadth, 54 miles; area, 1963 English square miles. It is generally flat, and has much alluvial soil, well fitted both for arable and grass husbandry. In the north-west, towards the Zuider Zee, are tracts of sand-downs and patches of underwood; and in the south-east heath and bog prevail. The principal streams are the Maas, Rhine, Waal, and Old Ijssel. The principal crops, in addition to the usual cereals, are rape, clover, flax, hemp, and tobacco; fruit also is abundant. The domestic animals, chiefly horses and cattle, are excellent. The manufactures, principally woollen, cotton, and linen goods, soap, salt, and glass, are carried on extensively in various quarters. The principal towns are Arnheim, Nijmegen, Thiel, and Zutphen. Pop. (1897), 555,686.

GELDERN (French, *Gueldres*), a town, Rhenish Prussia, at the confluence of the Niers and Blente, 27 miles north-west of Düsseldorf. It was founded in 1097, was the residence of the sovereigns of Gueldres till 1343, and had strong fortifications erected by Philip II., but which were razed by Frederick II. in 1764. Its principal buildings are two Roman Catholic and a Protestant church, and two hospitals. Pop (1895), 5974.

GELEE, CLAUDE. See CLAUDE LORRAINE.

GELL, SIR WILLIAM, a celebrated antiquarian and classical scholar, was born in 1777. He was educated at Jesus College, Cambridge, where he graduated as M.A. in 1804, and was for sometime a fellow of Emanuel College in that university. For many years he resided in Italy; first at Rome and afterwards at Naples. In 1814 the Princess of Wales (afterwards Queen Caroline) appointed him one of her chamberlains, and he accompanied her on her travels for several years, but being attacked with the gout was obliged to resign the appointment. He subsequently settled at Naples, devoting his time to literature. He died there, 4th February, 1836. His principal works are, The Topography of Troy, The Geography and Antiquities of Ithaca, The Itinerary of Greece, The Itinerary of the Morea, The Topography of Rome, and the interesting and beautiful work, Pompeiana, or Observations upon the Topography, Edifices, and Ornaments of Pompeii.

GELLERT, CHRISTIAN EHREGOTT, an elder brother of the poet, was born at Haynichen, near Freiberg, August 11, 1713. There is no notice of his early school-life, though it doubtless resembled the poet's; but in 1736 and 1737 he became professor at a gymnasium in St. Petersburg, and adjunct of the Academy of Sciences there for ten years more. He then returned to Freiberg, where he gave lectures on metallurgy; and in 1750 published his Elements of Metallurgic Chemistry, and was appointed (1753) councillor and inspector of mining operations. In 1755 appeared his Elements of Assaying; in 1762 he became superintendent-in-chief of mines, and finally, in 1765, professor of metallurgy in the newly-established Mining Academy. He died at Freiberg, May 18, 1795. He published a few papers, and tried many metallurgic improvements. His Elements of Chemistry was an excellent work.

GELLERT, CHRISTIAN FÜRCHTEGOTT, a German poet, was born, 1715, at Haynichen, a city near Freiberg, in the Erzgebirge, where his father was a preacher. On account of the narrow circumstances of his father, who had a family of thirteen children, Gellert, at the age of eleven, was obliged to support himself by copying. His first poetical attempt—a poem on his father's birth-day—he made at the age of thirteen. In 1729 he was sent to the royal school at Meissen. In 1734 he began the study of theology at Leipzig. He assisted Gottsched in the translation of Bayle's Dictionary. He also wrote fables, stories, didactic poems, with several prose essays, besides comic and idyllic pieces intended for the improvement of the stage. With a view of adding to the dignity and utility of romance, he wrote his Schwedische Gräfin (Swedish Countess). He was much afflicted at times with hypochondria. For twelve years he had lectured in Leipzig with much applause, when he was appointed extraordinary professor of philosophy there in 1751. He now read a course of very popular lectures on poetry and eloquence. The melancholy to which he was subject, however, made him renounce poetry and devote himself to lectures on morals. During the Seven Years' war great numbers of strangers visited Gellert, who had become the favourite of the nation. Frederick the Great was so much pleased with his conversation that he called him *le plus raisonnable de tous les savans*

Allemands. Gellert received numerous presents and other proofs of regard both from his scholars and from strangers, and was surrounded with most of the external means of happiness; but his health grew worse and worse, and his complaints refusing to yield to medicine he died, December 13, 1769. His private character was highly amiable. No literary man was ever more ready to allow the merits of others. Though not a genius of the first class he was an agreeable and fertile writer, the poet of religion and virtue. In his fables and spiritual songs he has displayed the whole force of his genius. The former are characterized by a delicate vein of humour, liveliness, ease, and keen satire. In his tales he is fond of the serious, didactic style, and sometimes of the tragic. His verses are soft and harmonious. For romance he had no talent, as is shown by his Swedish Countess. His theatrical pieces, though better, are still a failure. His letters, for the time when they were written, are worthy of praise, though they are not wholly free from the faults of the age. The first edition of his complete works appeared in 1769–74, in ten volumes.

GELLIUS, AULUS, a Roman author, who lived under Hadrian and the Antonines, in the second century after Christ. He studied rhetoric at Rome and philosophy at Athens, and practised as a lawyer at Rome. He is the author of Noctes Atticæ (Attic Nights), full of interesting observations and quotations, from the best Latin and Greek authors, relating to language, literature, history and antiquities. This work was partly compiled in the winter nights during his residence at Athens. It is now of great value, as the authors from which he drew his materials are in a great measure lost. Among the best editions we may mention that of Hertz (Berlin, 1883–85, two vols.).

GELNHAUSEN, a town of Prussia, district of Cassel, on the right bank of the Kinzig. It rises in terraces on a hill side, and has old walls, ramparts, and gates. Its principal buildings are two churches, one of them a Romanesque structure of the thirteenth century, with fine carvings and painted glass; and an old palace (recently restored) on an island of the Kinzig, in which Frederick Barbarossa, and several of his successors, used to reside. Gelnhausen was formerly an imperial city and a place of importance. Pop. (1895), 4496.

GELON, son of Dinomenes, tyrant of Gela, and afterwards of Syracuse. He is first met with in history as one of the body-guards of Hippocrates, then tyrant of Gela. He so distinguished himself in the wars of the period that he was promoted to the chief command of the Geloan cavalry. On the death of Hippocrates the people of Gela rose against his sons, whose cause was at first espoused by Gelon. The people were defeated, but Gelon made use of his victory to set aside the young princes, and retained the sovereign power for himself (491 B.C.). About 485 B.C. the oligarchical Syracusan exiles (the Gamori) implored the assistance of Gelon, who determined to restore them by force of arms. On his appearance before Syracuse the popular party threw open the gates and submitted without opposition to his power. From this time he bent all his energies to the aggrandizement of his new capital. Half the inhabitants of Gela, and many of the wealthier classes of Camarina, Eubœa, and other cities, were compelled to settle in Syracuse, which thus became one of the most powerful and prosperous towns of that period. When Greece was threatened by Xerxes Athens and Sparta sent ambassadors to Gelon to conclude an alliance against the King of Persia. Gelon offered 206 galleys and 28,000 men, with provisions for them during the war, if they would yield to him the supreme command by land and sea. The conditions were rejected. Gelon therefore refused the desired assistance, and sent to Delphi a man of the name of Cadmus, with orders to await the result of the war, and if the Greeks were overcome, to pay homage to Xerxes in his name, and to send him valuable presents. He was not then aware that Xerxes had induced the Carthaginians, while he was assaulting the Greeks in their own country, to make an attack on their settlements in Sicily and Italy. Hamilcar finally landed at Panormus with a fleet of 2000 ships of war and 3000 transports, carrying, in all, 300,000 land troops, and laid siege to Himera. Gelon marched against this army with 50,000 infantry and 5000 cavalry. He learned that Hamilcar intended to engage in a solemn sacrifice the next day, and to receive auxiliary troops into his camp. Gelon succeeded in introducing, in the room of the auxiliaries, a detachment of his own cavalry into the enemy's camp, which fell upon Hamilcar in the midst of his religious ceremony, slew him, and set fire to his ships. At the same time Gelon assailed the Carthaginians, who were dejected by the death of their general and the loss of their fleet, and totally defeated them. This remarkable battle is said to have happened on the same day on which the Greeks were victorious at Salamis (480 B.C.). It is celebrated in an ode by Pindar. The booty was immense, and Gelon offered the Carthaginians peace only on condition of their paying a large sum towards the expenses of the war, and, some add, of abolishing human sacrifices. In order that he might obtain for his usurpation of the supreme power the stamp of selection by the public voice, he professed to wish to retire to a private station, and appeared unarmed before an assembly of the people, declaring this to be his intention. The people would not hear of it, however, and hailed him as their preserver and sovereign. He died two years after his victory (478 B.C.), and was succeeded by his brother Hieron.

GELOSE, a pectic substance containing—carbon, 42·77; hydrogen, 5·775; oxygen, 51·455; prepared by Payen from a commercial article entitled *Chinese moss*, which consists of long white threads made up into bundles, is used for food, and is said to be the juice of a lichen growing on trees in the south of China and in the Philippine Islands. It has also been obtained by the same chemist from several kinds of sea-weed. The moss, when boiled in water, dissolves, with the exception of 2 or 3 per cent of nitrogenized corpuscles and traces of other matter, and on cooling it forms a transparent colourless jelly, containing 500 times its weight of water, and yielding ten times as much as the best gelatine. When dried the residue constitutes gelose, and this is distinguished from other bodies by certain characteristic reactions. From its high gelatinizing power it might possibly be substituted for ordinary gelatine, and it might therefore be worth while looking for it in the sea-weeds of our own coasts.

GEMARA. See TALMUD.

GEMINI, the Twins (♊), the third sign of the zodiac. The sun enters this sign on or about May 21, and leaves it on or about June 21. The name belongs also to a northern constellation, of which the two chief stars are Castor and Pollux. They are very nearly equal in brilliancy, which fact probably suggested the name. Pollux is slightly the brighter. It is a quadruple star. Castor is one of the finest of the double stars.

GEMS, or precious stones, are sometimes found crystallized in regular shapes and with a natural polish, more commonly of irregular shapes and with a rough coat. The term gem often denotes more particularly a stone that is cut, polished, or engraved,

and it also includes pearls and various artificial productions. The diamond is the hardest of all known substances, and in beauty and value stands foremost among precious stones, though the ruby, if of the weight of two or three carats, fetches a higher price. The hardness of the diamond is marked as 10. It consists of pure carbon, and is found of all colours, though generally colourless. Its beauty when cut is owing to its refracting powers, by which it throws back much of the light that falls on it. The ruby and sapphire belong to what is called the *corundum* group of stones, all composed of alumina. The ruby is of a rich blood colour, the sapphire of a beautiful blue. The spinel, a compound of alumina and magnesia of hardness 8, is of various colours, the red variety being the balas ruby. Topaz is a gem of various colours, yellow, pink, blue, &c. Emerald is of a beautiful green, hardness 7·5 to 8; value generally next to the ruby. Beryl is a pale green or blue stone of little value; garnet, often a beautiful red colour, is also little prized. Chalcedony, onyx, sardonyx, cornelian, agate, jasper, are all varieties of quartz (hardness 7), and often appear as beautiful gems. Opal, well known from its changing hues, is a very valuable stone, rather softer than quartz. Turquoise, when of a fine azure blue, is also valued. Lapis-lazuli, malachite, amber, and coral, may also be classed among the gems. Gems have been known and prized from very early times, and the ancients (Egyptians, Greeks, Romans, &c.) were acquainted with the art of cutting, engraving, and carving them in an artistic manner. (See GEM-SCULPTURE.) The cutting and polishing of gems is a delicate and somewhat tedious process. Diamond-powder is much employed in the process. It is with this that the diamond itself is polished, and it is also used on a variety of other stones, which, without it, indeed, would have been of little value. For the composition, &c., of gems, see AGATE, BERYL, CORUNDUM, DIAMOND, EMERALD, GARNET, &c.

Artificial Gems.—The great value which has at all times been attached to precious stones has led to many attempts to imitate them. The art of glass-colouring was known to the early Egyptians, who produced excellent imitations of the most beautiful gems. Among the Romans in the time of Pliny the manufacture of false stones was far advanced as a branch of industry. There existed several treatises on the subject, and Pliny declared that it was a difficult task to distinguish the false gem from the true. The alchemists of the middle ages, according to St. Thomas Aquinas, successfully fabricated artificial jewels, and he instances the jacinth, sapphire, emerald, topaz, and ruby as being skilfully counterfeited. About the middle of the seventeenth century false stones were no longer manufactured according to methods differing for each stone, but according to a general formula much the same as that followed at the present day.

The base of all modern artificial gems is a peculiar kind of glass of considerable hardness, brilliancy and refractive power called *paste* or *strass*, which is distinguished from ordinary glass by the presence of 50 per cent. of oxide of lead among its constituents. When the strass is obtained very pure it is melted and mixed with substances having a metallic base, generally oxides, which communicate to the mass the most varied colours. We give a few details showing how the principal gems may be imitated. The *diamond* being colourless, pure strass simply cut into brilliants and roses is used as a counterfeit. The *ruby* is imitated by mixing 1000 parts strass, 40 parts glass of antimony, 1 part purple of Cassius (a preparation of gold and binoxide of tin), and 1 part in excess of gold. *Sapphires* are counterfeited by 1000 parts strass, and 25 oxide of cobalt. *Topas*, same formula as for ruby, without the excess of gold, and heated for a less time. *Emerald*, 1000 parts strass, 8 oxide of copper, and 0·2 oxide of chromium. *Amethyst*, 1000 parts strass, 25 oxide of cobalt, and a little oxide of manganese. *Garnet*, 1000 parts strass, and a variable quantity of purple of Cassius according to the shade to be obtained. In all these preparations success mainly depends upon a thorough pulverization and mixture of the ingredients; the fusion should be long continued at a graduated and uniform maximum temperature, and the mixture be annealed in cooling. These imitations, which are made in fabulous quantities in large factories in France and elsewhere, are chiefly used in the manufacture of cheap jewelry. Attempts have, however, been made with a fair measure of success to manufacture true gems by artificial processes. Of these processes we need only mention one of the most recent, namely, that introduced by the French chemists Fremy and Verneuil. They succeeded in manufacturing excellent rubies, exactly like natural ones in shape and composition, by raising carefully to a red heat a mixture of alumina, barium fluoride, and a very small quantity of bichromate of potash. The rubies are found in a friable matrix. If a little cobalt oxide be present in the mixture, sapphires are obtained instead of rubies. Many experiments with a view to producing diamonds artificially have been made within recent years. From hydrocarbons, subjected to a very intense heat and enormous pressure, minute crystals have been obtained which are as hard as the natural diamond, scratching all other crystals, and not affecting polarized light. They have been produced with curved faces belonging to the octahedral type, and diamond is the only substance crystallizing in this form. The process is, however, expensive, tedious, and dangerous, and the diamonds so produced are yet too small to represent anything beyond a scientific value.

GEMS-BOK, the *Oryx gazella* of zoologists, and the *kookam* of the natives, is a large powerful member of the Antelope family, inhabiting the arid plains of South Africa. It equals the domestic ass in size, and measures nearly four feet at the shoulder. The hide is marked with unblending, bold, contrasting tints; the general hue is gray, but along the back, on the hindquarters, and along the flanks the colour is deep black. A black streak also crosses the face, and passes under the chin. The gems-bok has a short erect mane, a long sweeping black tail, and long sharp-pointed heavy horns, nearly straight from base to tip, and obscurely ringed throughout the lower half. By the aid of these natural bayonets it can easily defend itself from the smaller Carnivora, and it has been known to drive off, and even kill, the lion himself. It is asserted that the gems-bok never drinks water, the moisture which it needs being obtained from the succulent bulbous plants on which it feeds.

GEM-SCULPTURE, the glyptic art, or lithoglyptics; the art of representing designs upon precious stones, either in raised work (*cameos*) or by figures cut into or below the surface (*intaglios*). The latter method may have been practised at a very early period, and probably had its origin with the Babylonians, who worshipped the heavenly bodies, and were accustomed to wear figured talismans, which served as symbols of their influences. From them the custom of wearing engraved stones passed to the Hebrews. According to others this art originated in India. The Egyptians cut the hardest kinds of stones. The custom of wearing cut stones as seal rings appears to have been general among the Greeks in the time of Solon. One of the earliest

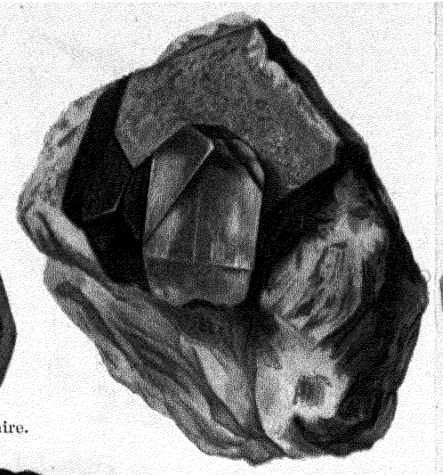
GEMS.



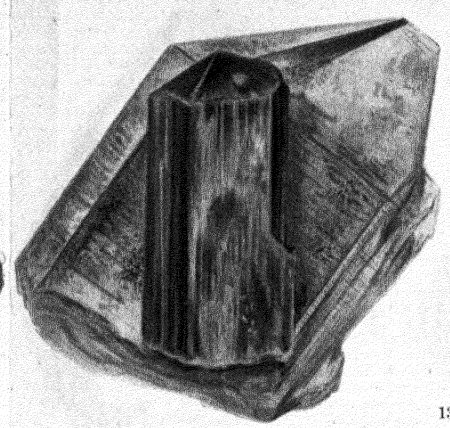
1, Topaz.



12, Sapphire.



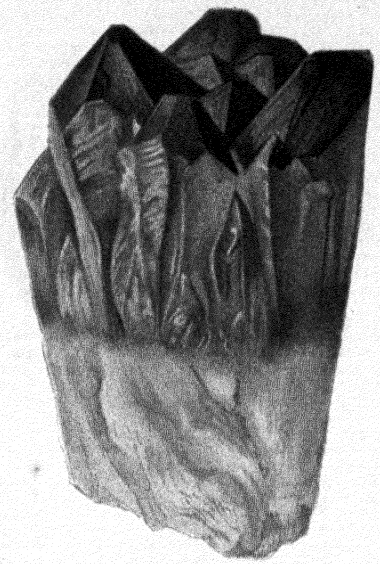
2, Topaz.



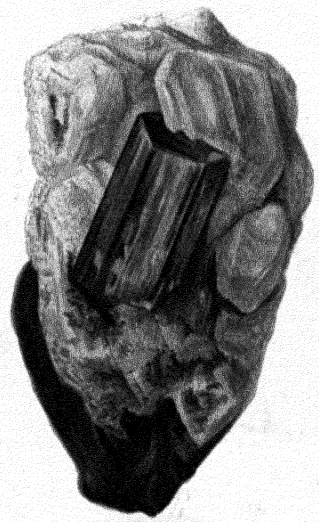
3, Topaz.



13, Ruby.



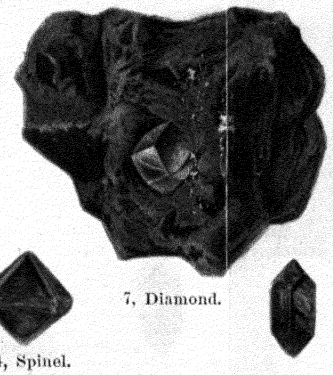
4, Amethyst.



5, Emerald.



6, Lapis-lazuli.



7, Diamond.

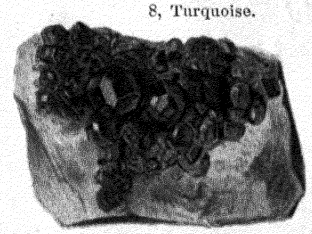


14, Spinel.

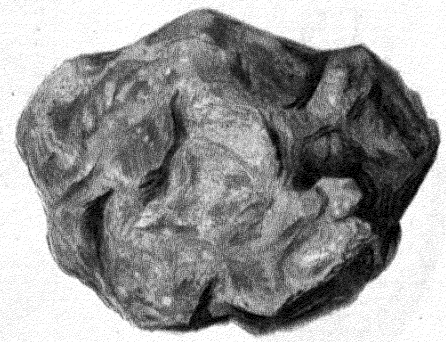
15, Hyacinth.



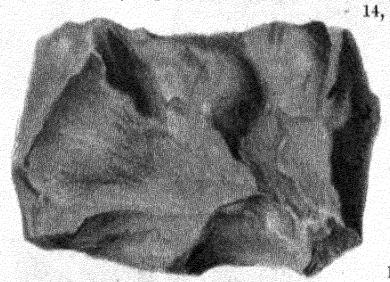
8, Turquoise.



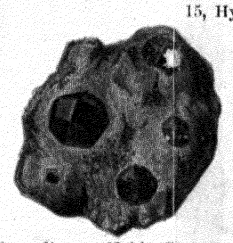
16, Garnet.



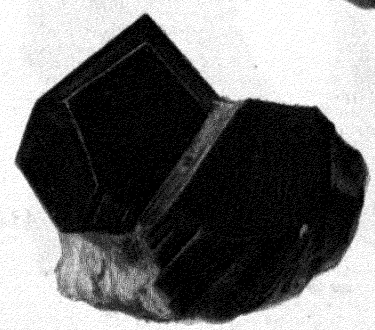
9, Opal.



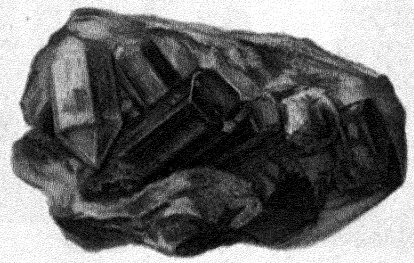
10, Chrysoprase.



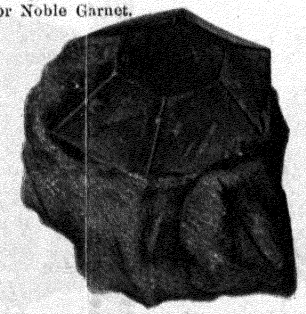
11, Almandine or Noble Garnet.



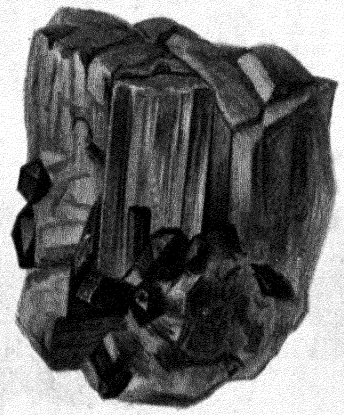
17, Tourmaline.



18, Tourmaline.



19, Chrysoberyl.



20, Aquamarine.



21, Heliotrope or Bloodstone.

Printed from the Originals by the Bibliographisches Institut, Leipzig.

artists in this branch of whom mention is made, is Mnesarchus, the father of the philosopher Pythagoras, consequently a contemporary of that Theodorus of Samos who engraved the ring of Polycrates, of which such wonderful stories are told by the ancients. These ancient works were probably *intaglios;* the artist made use of the lathe, the diamond point, and diamond powder. Respecting the species of stones chiefly used by the ancients, and the mystical powers attributed to the different kinds, see Bellermann's Urim und Thummim, die ältesten Gemmen (Berlin).

Whether the Egyptian *scarabœi*, and the Græco-Etruscan imitations of them, are the most ancient specimens of this interesting art, may be doubted on account of the form of the stones (cut into the shape of beetles). Yet the specimens of the early period of the art are so rare, that we have not sufficient data for fixing on any class as prior to that just mentioned. The art seems to have been in a flourishing condition in the age of Alexander the Great; but we are able to judge of the works of Pyrgoteles, Apollonides, and Cronius only from tradition, as there are no works of these masters extant. Pyrgoteles was distinguished for works in relief; and from his time the art may have risen gradually to that degree of perfection of which we possess such rich specimens. The artists, some of whose names we learn from their works themselves, often took the master-pieces of sculpture for their subjects and models. Under the Roman emperors, in particular, this was very common. The chief early Greek engraver whose name is known from extant works of his is Dexamenos (late fifth century). The names of Dioscorides, Apollonides, Aulos, Hyllos, Cneius, Solon, remind us of the most perfect works in this branch of art. But some of the greatest ancient works—the sardonyx of the Sainte Chapelle (Paris); the apotheosis of Augustus at Vienna; the onyx at the Hague, representing the apotheosis of the Emperor Claudius; Achilles lamenting Patroclus; the head of Julius Cæsar, (Agincourt's Sculpt. pl. 48),—these, like the Brunswick vase, and the Trivulcian and Neapolitan cups, bear no distinguished names. Pompey consecrated the dactyliotheca or collection of rings of Mithridates as a votive offering in the Capitol; Julius Cæsar, six tablets, with six gems, in the temple of Venus. At a later period the collections of Herodes Atticus, of Vespasian, &c., were celebrated; yet this general taste was not able to preserve the art from decline. Notwithstanding the decline of the art, however, gems continued to be highly prized, even in the times of the greatest barbarism, and served to ornament the shrines of saints, royal badges, and ceremonial dresses, and thus passed safely through the ages of destruction and ignorance, in which the finest statues were valued as materials for mortar or for building, till ages arrived which could appreciate their value. If we may judge from the remains which have come down to us, engraved gems seem to have been more common in the Byzantine empire than in the west. A splendid collection of antique gems is accessible to the public in the British Museum. See King's Antique Gems and Rings (1872), and Middleton's Engraved Gems of Classical Times (1891).

The earliest gem-engraver of modern times is Vittore Pisanello, who lived at Florence about the year 1406. Among the Germans, Daniel Engelhard, of Nuremberg, was the earliest. He died in 1512. The discovery of some fine specimens in Italy, particularly at Florence, and the display of gems by the Emperor Palæologus, at the Council of Florence, in 1438, were perhaps the original cause of the taste of the Medici for engraved stones. The popes and that family were the first patrons of this art in modern times. A Florentine artist, generally called, on account of his great skill, *Giovanni delle Carniole* ('of the Cornelians'), distinguished himself in this early modern period. There are few gems which can be ascribed to him with any confidence, besides the famous cornelian in the Florentine Museum, with the portrait of Savonarola, bearing the inscription *Hieronymus Ferrariensis ordinis prædicatorum, propheta, vir et martyr.* This stone, which must have been engraved later than 1498, is given in Agincourt's Sculpture (tab. 48, number 82). Contemporaries and rivals of Giovanni were Nanni di Prospero delle Carniole, in Florence, whom Francesco Salviati directed in his works, and Domenico Compagnie (*dei cameï*), a Milanese, whose portrait of Ludovico Sforza called *Moro*, cut in a ruby, is still preserved in the Florentine Museum. After Bernardi (*delle Carniole*), Valerio Vicentino (under Leo X.) rendered himself famous as a gem-engraver. This art found patrons in all the Italian princes; the number of artists constantly increased, and the sphere of their art was extended. The names of the artists, however, are not generally known, because they were rarely put upon the stones. Many gems, too, are still concealed in the cabinets of the wealthy, or the treasuries of princes. Until these are as accurately described as those of the Ambrosian collection, it will be difficult to obtain a complete general view.

Subjects of antiquity were preferred by these artists, who treated them with such ability that it often requires the skill of the most accomplished connoisseur to distinguish them from genuine antiques. The dispute concerning the famous seal ring of Michael Angelo is well known It is not improbable that this cornelian is the work of Pietro Maria da Pescia, as the figure of the fisherman in the exergue may indicate that artist, who, with Michelino, belonged to the age of Leo X. (Fiorillo, Essays, vol. ii. page 188). In order to give the gems more completely the appearance of antiques, some artists engraved their names in Greek, but with so little knowledge of the language that they sometimes betrayed themselves by this artifice. To this time we must ascribe the gems with the name *Pyrgoteles*, which Fiorillo endeavours to prove were the works of an Italian of Greek descent (Lascaris).

The art of engraving was also applied to glass and gold. The crystal box of Valerio Belli, the most skilful and industrious artist in this branch during the sixteenth century, deserves particular mention. It was intended by Clement VII. as a present to Francis I., when Catharine of Medici went to Marseilles in 1533. At present it is in Florence. Drawings of it are to be found in Agincourt's Sculpture (table 43) and in Cicognara (ii. table 87).

The Milanese particularly distinguished themselves in gem-sculpture, as the wealth of the principal citizens of Milan enabled them to patronize this art. Jacopo da Trezza, the same artist who, in 1564, executed for Philip II. the famous tabernacle of the Escurial, made the first attempts at engraving on the diamond in Milan. The greatest cameo work of modern times is the stone in the Florentine Museum, 7 inches in breadth, upon which Cosmo, grand-duke of Tuscany, with his wife, Eleonore, and seven children, are represented. A Milanese, John Anthony de Rossi, who was a contemporary of the Saracchi family (about 1570), is the artist. The Saracchi were five brothers, and the crystal helmet of Albert of Bavaria is a proof of their skill. See Cicognara's Storia della Scultura, edizione di Prato, v. p. 446.

The first traces of gem-engraving in Germany are found in the fourteenth and fifteenth centuries, in Nuremberg and Strasburg, in the former of which towns Daniel Engelhard appears as the earliest

engraver of dies in Germany. Natter, himself a distinguished artist in gem-engraving, has given an account of his predecessors in his Traité de la Méthode Antique de graver en Pierre Fine, comparée avec la Méthode Moderne (London, 1755). Natter, along with Pichler and Marchant, are considered as the restorers of this art in that country. The most eminent artist of more modern times is, perhaps, Berini, a native of Rome, who with Cervara and Giromelli at Rome, and Putinati at Milan, produced very fine works. But at the present day gem-engraving in a really artistic manner seems hardly to be practised anywhere. Many fine ancient engraved gems have been discovered by modern research.

GENDARMES, or GENS D'ARMES, the name originally given in France to the whole body of armed men (*gens armata*), but after the introduction of standing armies to a body of heavy-armed cavalry, which composed the chief strength of the forces, and was provided with helmets, cuirasses, pistols, horses protected with armour, &c. After the time of Louis XIV. they had only pistols, helmets, and swords. Part of them were under the immediate orders of the king, part composed the first body of the French cavalry. The latter consisted of men of rank, and belonged to the troops of the royal household. At the revolution this body was broken up. The name *gendarmes* has since been given to a corps which succeeded the former *maréchaussée*, employed in the protection of the interior. It was composed of infantry and cavalry, and belonged to the military, but served principally to enforce the police regulations. Under Napoleon it was a distinction to serve in this corps, because only veterans were employed in it; but the members were hated in a high degree, because they had to execute so many odious orders. When the German nations rose against Napoleon *gendarmes* were killed wherever they were found. The Bourbons retained this corps; and they are said to have behaved generally with great moderation; yet the people continued to hate them as the instruments of tyranny. By a decree of 1869 the gendarmerie was divided into twenty-seven legions, of three to four companies each. Under the second empire, instead of protecting the lives and properties of the lieges, the gendarmes were used as a means of controlling the elections, and generally as a political police, so that even now the institution is far from popular. The force is still recruited from the army, such men as are notable for good conduct and intelligence being selected.

GENDER, in grammar, a difference in words to express distinction of sex. Strictly speaking there are but two genders, the *masculine* and *feminine;* words which did not belong to those classes were said to be *neutrius generis*, of neither gender; and from this phrase grammarians have, somewhat incorrectly, come to speak of this third class as being of 'the neuter gender,' and thus recognize three genders. That the distinction of sex is the origin of grammatical gender cannot be reasonably disputed, and as a consequence the principle must have been originally restricted to living beings, and practically to those in which the distinction of sex was readily perceived. In the lesser animals it would have been more difficult to ascertain the sex, and generally unnecessary to denote it. But correctness and utility are not the only ruling principles of language; they are often sacrificed to the love of imagery and personification. In the infancy of language, when everything that was seen to produce an effect was conceived as actuated by a conscious will, every prominent object was endowed with one or other sex, the choice depending on the association of ideas. Strength, freedom, magnitude and violence are the marked attributes of the male; weakness, subjection, timidity, and gentleness of the female. In Hebrew there is no neuter; in Sanskrit, Greek, and Latin, the majority of the names applied to inanimate objects are either masculine or feminine; and in the languages derived from the Latin —Italian, French, Spanish, and Portuguese—a neuter gender is not recognized. In German, as in the classical tongues, the names of inanimate objects are sometimes masculine and feminine as well as neuter. English, getting rid of the spurious distinction that encumbered the Anglo-Saxon, attributes sex only to living beings. In the highly inflected languages there are certain terminations distinctive of the different genders, the most characteristic in the Greek being *os*, masc.; *ē*, fem.; and *on*, neuter; and the Latin *us*, *a*, *um*. In English the distinction of gender is often marked by the termination, the most common being the affix *ess* derived from the French; or by a different word, as boy, girl, man, woman, &c. In most other languages the adjectives, articles, and participles are inflected for gender; in English the gender of a noun only affects the pronoun substituted for it.

GENEALOGY (from the Greek *genos*, race, and *logos*, discourse). The systematical account of the origin, descent, and relations of families is an auxiliary of historical science. Genealogical knowledge becomes important in a personal or legal view, when family claims are to be established. Genealogy is founded on the idea of a lineage or family. Persons descended from a common father constitute a family. Under the idea of degree is denoted the nearness or remoteness of relationship in which one person stands with respect to another. A series of several persons, descended from a common progenitor, is called a *line*. A line is either direct or collateral. The direct line is divided into the ascending and descending. As far as the seventh degree particular names are given to the progenitors by the civil law (*pater, avus, proavus, abavus, atavus, tritavus, protritavus*), and to the descendants (*filius, nepos, pronepos, abnepos, atnepos, trinepos, protrinepos*). The other ascendants are called, in general, *majores* (ancestors), and the other descendants *posteri* (or posterity). The collateral lines comprehend the several lines which unite in a common progenitor. They are either equal or unequal, according as the number of the degrees in the lines is the same or different. The collateral relations on the father's side are termed *agnati*, on the mother's *cognati*. Children stand to each other in the relation either of the full blood or the half blood, according as they are descended from the same parents, or have only one parent in common.

For illustrating descent and relationship genealogical tables are constructed, the order of which depends on the end in view. In tables, the object of which is to show all the individuals embraced in a family, it is usual to begin with the oldest progenitor, and to put all the persons of the male or female sex in descending, and then in collateral lines. Other tables exhibit the ancestors of a particular person in ascending lines, both on the father's and mother's side. In this way 4, 8, 16, &c., ancestors, are exhibited. The tables showing the succession of rulers contain merely the descent of the persons who have reigned in succession, or who have claims to the government. In connection with them stand the tables of disputed succession, which represent several lines of a family, or several collateral families, in order to deduce their rights of succession from their degree of relationship. Synchronical tables consist of the genealogies of several families placed together, in order to compare, with facility, relationships, marriages, divisions of inheritance, &c. Historical genealogical tables differ from mere genealogical tables, as they attach to the descent the biographies also of

the members. There are also tables which show, besides the succession of the families, the diminution or increase of the family property. The common form of genealogical tables places the common stock at the head, and shows the degree of each descendant by lines. Some tables, however, have been constructed in the form of a tree, after the model of the canonical law (*arbor consanguinitatis*), in which the progenitor (German, *Stammvater*) is placed beneath, as if for a root—a form in which the ancient genealogists delighted. Genealogical knowledge was most important in the middle ages, when the nobility was distinct from the other classes, laying exclusive claim to certain offices, situations, &c., and every one who wished to obtain them had to show a certain number of ancestors. Then arose the passion of referring to the remotest antiquity, or at least to Roman families, for the founders of the royal families of Europe. See Sir Bernard Burke's Geneal. and Heraldic Dict. of Peerage and Baronetage; Geneal. and Heraldic Dict. of Landed Gentry; Geneal. and Heraldic Hist. of Commoners; Sir Harris Nicolas's Historic Peerage; Walford's County Families.

GENERAL, in the army, the highest military title, with the exception of that of field-marshal. In the British service there are three ranks, the highest *general*, the second *lieutenant-general*, and the lowest *major-general*. There is also a temporary rank, that of *brigadier-general*, bestowed very frequently on the senior regimental officer of the corps composing the brigade.

General, in the Roman Catholic Church, is the title given to the supreme head, under the pope, of a monastic order. In most of the orders he is elected for three years, but by the Jesuits for life, but the election must be confirmed by the pope. It is his duty to inquire into particular abuses, or to decide in such important controversies as may arise among the members of the order, and he holds a general chapter of the order at stated times, which differ according to the usage of the several orders. The general is exempt from episcopal jurisdiction, being immediately responsible to the pope himself.

GENERAL ASSEMBLY. See ASSEMBLY (GENERAL).

GENERAL ISSUE, in law, is that plea which denies at once the whole declaration or indictment, without offering any special matter by which to evade it. It is called the *general issue*, because, by importing an absolute and general denial of what is alleged in the declaration, it amounts at once to an issue, or fact affirmed on one side, and denied on the other. This is the ordinary plea upon which most causes are tried, and is now almost invariably used in all criminal cases, when the prisoner at the bar pleads 'not guilty;' to money counts the plea is 'never indebted;' or to actions on simple contract '*nunquam assumpsit*' (never undertaken). This plea puts everything in issue, that is, denies everything, and requires the party to prove all that he has stated. It is a frequent question, What can be given in evidence by the defendant upon this plea? and the difficulty is, to know when the matter of defence may be urged upon the general issue, or must be specially pleaded upon the record. In many cases, for the protection of justices, constables, excise officers, &c., they are, by act of Parliament, enabled to plead the general issue, and give the special matter for their justification, under the act, in evidence.

GENERALIZATION, in logic, is the act of comprehending, under a common name, several objects agreeing in some point which we abstract from each of them, and which that common term serves to indicate. Generalization implies abstraction, but it is not the same thing, for there may be abstraction without generalization: when we are speaking of an individual it is usually an abstract idea that we form; for instance, say we were speaking of the Queen of England; she must actually be sitting either at Windsor or elsewhere; sitting, standing, or in some other posture, in such a dress, &c. Yet many of these circumstances which are regarded as non-essential to the individual, are quite disregarded by us, and we abstract from them what we consider as essential, thus forming an abstract notion of the individual, yet there is here no generalization. Sometimes the common property in a variety of objects is prominent and universally observed, as when we identify the circular form amidst all differences of material, size, and colour. At other times, so great has been the amount of difference, that ages have elapsed before the resemblance was perceived; thus the fall of an apple was never suspected before the time of Newton to have anything in common with the motions of the heavenly bodies. See CLASS, INDUCTION, LOGIC.

GENERAL LIEN, the right to retain possession of a chattel until payment be made, not only of any debt due in respect of that particular chattel, but of any balance that may be due on general account in the same line of business. General liens do not exist at common law, but depend entirely upon contract express or implied from the special usage of dealing between the parties. Attorneys have a lien for the balance of their accounts over the papers of their clients; bankers, factors, warehousemen, and others have also a lien for the amount due to them on the general balance of their accounts. It has been disputed whether carriers have a general lien over the goods intrusted to them, but the current opinion is that they have. The master of a ship has no lien on the vessel or her freight for his disbursements on her account, but has the same lien for his wages as a seaman (17 and 18 Vict. cap. civ. sec. 191). In the Scottish law the doctrine of lien is known by the name of *retention*.

GENERAL SHIP, in maritime law, is a ship announced by the owners to take goods from a particular port at a specified time, and which is not under special contract to particular individuals. If a general ship has been advertised as being bound for any particular port, the owners must give specific notice to every shipper in case of an alteration in her destination; otherwise they will be held liable for any loss by damage or detention which may thereby happen. The master of the ship being intrusted by the owners with full power to contract for and take in goods, no agreement for freight which may have been made with the owners, without his knowledge, will be effectual to secure room in the vessel.

GENERATED is used by mathematicians to denote whatever is formed by the motion of a point, line, or surface. Thus a line is said to be *generated* by the motion of a point; a surface, by the motion of a line; and a solid, by the motion of a surface. The same term is also sometimes used in a similar sense in arithmetic and algebra. Thus 20 is said to be generated by the two factors 4 and 5, or 2 and 10; *a b*, by the factors *a* and *b*; &c.

GENERATION. In ancient chronology time is sometimes divided according to generations, or the mean duration of human life. Herodotus reckons 100 years to three generations. Other writers take 30, 28, 22; Dionysius of Halicarnassus 27 years for a generation. The number commonly adopted is 30 years.

GENERATION. This word is popularly used as a measure of time, and usually represents about thirty years, the period which man requires to attain maturity, and the age at which, as a general rule,

fruitful marriages are contracted. This secondary sense of the term is thus indirectly derived from the primitive meaning, which has reference to the origin of living things. In the higher animals and plants the offspring is due to the congress of distinct individuals or elements, as will be explained in the article REPRODUCTION; but alongside of this process, sometimes even concurrently with it, new forms may arise by fission, or by budding; by a process akin to the latter, as in the *parthenogenesis* of bees, &c.; or by a combination of the sexual and asexual processes, *alternate generation*. See GENERATION (ALTERNATE).

GENERATION, ALTERNATE. This phrase is unfortunate, inasmuch as it tends to confusion between the popular and scientific uses of the word generation, and thus helps to perpetuate the mistaken notion that each member of the series of forms is an individual, or is anatomically and functionally a complete zoological or vegetable unit. *Metagenesis*, the term proposed by Haeckel, is now becoming adopted by English physiologists as the name of that kind of multiplication in which, between two pairs of parents, capable of giving rise to an egg, there intervenes at least one form which either in structure, form, or functions is unlike, sometimes extremely unlike, its parents as well as the progeny to which itself gives rise. Among plants metagenesis occurs in Ferns, Lycopods, *Equisetum*, and Mosses, in short, nearly all cryptogamous families; among Phanerogams it is confined to those cases in which bulbils detach themselves from the parent stock and give rise to independent stocks. In some sense it may be said to occur in sponges, in which multiplication by buds alternates with the production of eggs. The Cœlenterate class *Hydrozoa* abundantly illustrates it: the Echinoderms, *Polyzoa*, *Tunicata*, the wheel animalcules, Nematoid worms, flat-worms, tape-worms, several of the true Annelids; among Crustaceans, *Daphnia*, Phyllopods; among Insects, the plant-lice and *Cecidomyia*. Chamisso in 1819 discovered the remarkable cycle of forms in the *Salpæ*, and in 1842 Steenstrup gave the name alternate generation to the mode of development which had then been observed in other groups than the *Tunicata*. The essential character of the process is that the zoöid (to use Huxley's term for a form which is not a perfect individual), which issues from an egg, gives rise by fission or budding to two individuals which repeat the true reproductive process and produce an egg. But the asexual multiplication by fission or budding may be indefinitely repeated before those forms appear from which the egg proceeds. Thus the plant-lice at the beginning of the season issue from the egg, but the familiar wingless insects which crawl over leaves and stems give birth to others similar to themselves, and this goes on for weeks, so that one egg in this manner gives rise to millions of beings; toward the close of the season winged forms appear, and these produce the eggs whence the next year's broods proceed. In the fresh water *Hydra* and in some Annelids the same zoöid which throws off the broods develops ova itself at a later period, thus combining the duties of nurse (Amme of German writers) with that of parent. But the dissimilarity of nurse and parent is often great; thus the fixed marine Hydrozoa, such as *Campanularia*, &c., throw off free swimming medusiform zoöids, and these develop the true reproductive elements from which in turn sessile forms emerge. The dissimilarity is often associated with variations of habit at the successive stages, notably in the parasitic worms. Thus the joints of the tape-worm are full of eggs, which, when taken into the body of a suitable 'host,' assume the cystic or bladder-worm form, of which the bladder-worm of the sheep's brain (the cause of sturdy) is an example. When the body containing these bladder-worms is eaten by a carnivore the tape-worms appear in the intestines of the latter. The Echinoderms, the nemertine worms, *Gephyrea*, some Polyzoa, and some insects of the family *Muscidæ*, undergo a process of metagenesis of a somewhat peculiar character. From the egg of the sea-urchin issues a ciliated larva, which shows bilateral symmetry: within the body of this larva, or nurse, as it may be called, arises a new form which appropriates the intestinal canal of the larva in part, and assumes the five-part or radial configuration which characterizes the group. The *Pilidium*, as the hat-shaped larva of some worms was called by Mueller, is nurse to a similarly produced adult. The tissues of the larvæ of *Cecidomyia* undergo degradation, and from the mass of formative matter thence resulting, the adult form is developed. There is thus an important difference between metamorphosis and metagenesis. In the former case there is a continuity in the life of the first product of the egg; in the latter the sequence is interrupted by the development, within the body of the first form which issues from the egg, of blastema or formative matter at a place and in a manner which is not characteristic of any ordinary function of nutrition; and the maturity of this secondary growth involves the destruction, in most cases the entire destruction, of all the larval or primitive body. The interruption of continuity in the development of the first product of an egg is most entire when fission is the process of multiplication.

GENERATION, SPONTANEOUS. The doctrine that living matter may originate spontaneously, that is, out of non-living matter, is of great antiquity. The sudden appearance of living things in dead bodies—of maggots in flesh, and mould on vegetables—was in those days when observation was not very minute, and experiment in physiological questions unknown, only intelligible on the hypothesis that the animal and vegetable matter had, when death reduced it to the condition of inorganic matter, given rise to these new forms. Redi showed that maggots were developed on the outside of the gauze which protected decaying meat, and thus demonstrated the share which flesh flies had in their production. But though he had shown that life was the necessary precursor of life, and though all experiment down to the present day has only confirmed his conclusions, in a large number of instances the difficulty remained, Might not the particles of that which had been living matter only alter their relations to each other, and thus give rise to new forms of life? in other words, Is the matter of a dead animal really dead? Has it simply ceased to be organized, and does it remain organizable? Are the particles of a putrescible or fermentescible substance simply used up in the nourishment of a living thing introduced among them, or can they readjust themselves so as to give rise to the Bacteria, the Torulæ, and the Infusoria with which such substances become crowded? Spallanzani first indicated the probability of these living things or their germs pre-existing in the atmosphere when he boiled solutions in vessels, the necks of which he elongated and bent downwards, for then, when solid particles could not enter contrary to gravitation, no life was developed in the vessels; and the same conclusion was pointed to by the attainment of the same result when the air which entered vessels containing fermentescible solutions was made to pass through sulphuric acid, through red-hot tubes, and through cotton-wool. That the air does actually contain large quantities of minute organic bodies was demonstrated by Tyndall in his efforts to obtain optically pure atmosphere, and this explains why preserved meats keep for any number

of years if properly closed, since, after their thorough cooking, the apertures are hermetically sealed while steam is still escaping, the entrance of atmospheric air with its contents being thus prevented. Lister's antiseptic treatment in surgery is based on the same hypothesis. Difficulties still exist, cases of the development of living things occurring after every precaution has apparently been taken; but as the number of these seeming exceptions is reduced by more careful experiments, it seems probable that they will all vanish when we have learned the limit of heat necessary for the destruction of the germs, and still more perfect means of filtering the air from all impurities. By means of experiment it has been shown that lumps of solid cheese put into infusions originate organic developments even after great heat has been used, while lumps of equal size, if reduced to powder before being subjected to heat, yield no such result; the solid lump, therefore, may retain and protect germs in its interior. It has been demonstrated that the efficacy of vaccine virus depends on the presence of certain solid particles, or *microzymes*, which multiply with enormous rapidity within the body; for when the lymph is carefully strained through membranes, the pure fluid is inert. Pasteur showed that the pebrine which ruined the silk trade of France by killing the caterpillars was no mystery, but was in reality a disease due to the introduction into the caterpillar's body of spores which there multiply. These spores are 1-6000th of an inch in length, and were named by Lebert *Panhistophyton*. They enter into the eggs of the parent, and thus constitute an hereditary disease transmissible on the female side. They enter the bodies of the caterpillars after contact with diseased individuals, and are also received into the alimentary canal, so that the disease is both contagious and infectious. Founding on this analogy, it has been suggested that diseases like scarlatina may be similarly explicable. But a difficulty here presents itself. Assuming the presence of special microzymes for each disease, are these bodies developed from introduced germs? or are they developed from the tissues of the sufferer in the same way that certain morbid growths in the human body are traceable to, so to speak, misdirected nutrition of an organ? The former view is now generally held as correct. To sum up: all theory, observation, and experiment go to show that there is no reason for believing in the spontaneous origin of living things at the present time, and even where the burden of evidence seemed strongest, the use of more delicate methods has proved the pre-existence of living things similar to those whose appearance seemed spontaneous. So far, therefore, *abiogenesis*, as spontaneous generation is better called, is without satisfactory support; while *biogenesis*, which assumes the dependence of living things upon previous living things, receives increasing confirmation. But biogenesis may be of two kinds: either the offspring may resemble the parent, and pass through exactly the same phases, constituting *homogenesis;* or the product of organic particles may pass through different phases, and result in dissimilar organisms. To this possible type of development, known as *xenogenesis* (Greek *xenos*, a stranger), it is possible that the epizootic diseases above alluded to may belong. The latter supposition, if verified, opens up an interesting field, since it would indicate the possibility of the development, from living tissues, of bodies indistinguishable from the lowest forms of animals and vegetables. But while spontaneous generation is untenable at present in regard to phenomena now in progress, we know nothing of the original development of living things. Evolution is incomplete as a scheme of the universe without the hypothesis of spontaneous origin of living things from inorganic matter. This is not the place to discuss this question, which is, however, beyond experience. But the value of the conclusions here stated is enhanced by the fact that the opponents of abiogenesis are to be found among those whose scientific conscience forbids them to accept a hypothesis which would, if supported by evidence, coincide with their opinions—would be indeed the complement of their opinions regarding evolution. See also in connection with this subject, the article GERM THEORY.

GENERIC NAME, in zoology and botany, the word (generally derived from the Greek or Latin) applied to a certain number of species (see SPECIES), to signify that they agree in the possession of certain characters, and are therefore all included in the same *genus*. Each species has also a specific name attached to it, and both terms together serve to mark out the individual species. Thus *Aquila chrysaëtus* denotes the golden eagle (genus *Aquila*); and *Bellis perennis* the daisy (genus *Bellis*).

GENESEE, a river of the United States, which rises in Potter county, Pennsylvania, flows north through New York state, and falls into Lake Ontario some 7 miles below Rochester, after a course of about 200 miles. At Rochester there are falls of 96 feet, giving abundant water-power, and below this other falls. Above these it is navigable for boats nearly 70 miles. Part of its course is in a deep rocky gorge or chasm, where there are several falls one of about 110 feet high. An aqueduct for the Erie Canal crosses this river at Rochester. The Genesee in its lower course waters one of the finest tracts of land in the state.

GENESIS, in mathematics, is nearly the same as *generation*, being the formation of a line, surface, or solid by the motion of a point, line, or surface in some definite manner.

GENESIS (Greek), creation, birth, origin. The first book of the Pentateuch is named in the Hebrew canon *B'reshith* (in the beginning), from the expression with which it commences; from the seventy translators of Alexandria (those who produced the Greek version known as the Septuagint) it received the name it is now commonly known by. Genesis consists of two great but closely-connected divisions:—1. The history of creation, the fall of man, the flood, the dispersion of the human race, chap. i.–xi. 2. The history of Abraham, Isaac, Jacob, and Joseph, including notices of the descendants of Abraham and Isaac in their collateral lines, chap. xii.–l. It would be entirely to mistake the character of the history of Genesis to view it as having other than a sacred purpose; yet even in a secular point of view there is no record that can be brought into competition with it. There is absolutely nothing in the whole range of ancient literature which could supply its place if this document were lost; while it is further to be observed, that if confidence cannot be placed in its authenticity, no reliable information exists on many subjects with which it is desirable man should be acquainted, and after which there is an intense longing in the human mind; as, for instance, the origin and early history of the race, a subject which, without the information supplied by Genesis, must be involved in impenetrable darkness. A certain apparent difference of style and language, the occurrence of what seem gaps on the one hand, and repetitions and contradictions on the other, and the use of two different terms for the divine name (*Jehovah* and *Elohim*) led very early to the question of the integrity of the book, and various critics have assumed larger or smaller interpolations. Many modern critics pronounce the whole Pentateuch, but especially Genesis, to be an aggregate of hetero-

geneous fragments, without, however, being able to agree as to their nature or the manner of their combination. For details on this subject see PENTATEUCH.

GENESIS OF SPECIES, a phrase chosen by Mr. Mivart as the title of a work in which objections are urged to the hypothesis of Mr. Darwin. The phrase has been pretty generally adopted, since it includes several other modes of development of new forms besides that with which the Origin of Species, the title of Darwin's great work, is identified. Thus, besides natural selection, sexual selection, and the independent origin of similar structures in animals and plants, may give rise to new specific forms.

GENET, the popular name of several digitigrade carnivorous mammals of the genus *Genetta*, family *Viverridæ*. The dentition and structural characters are the same as in the civet, but the anal pouch, which contains the glands secreting the odorous substance, is much less developed. The best known of these animals is the common or blotched genet (*Genetta vulgaris*), an inhabitant of Northern Africa, Southern Europe, and Western Asia, being found even in the south of France. It is a very beautiful and graceful animal. The general colour of the fur is gray, with a slight admixture of yellow. Upon this groundwork dark patches are lavishly scattered, and the full furry tail is covered with alternate bands of black and white; the length of the body is about 1 foot (the tail nearly as long), and the height about 5 inches. It is only semi-carnivorous, and in captivity will live entirely upon vegetable food. The claws are sharp, semi-retractile, and well adapted for climbing; the anal secretion has a musky odour; and, as in other nocturnal animals, the pupil is vertical. The habits of the genet are like those of the weasel tribe; it is easily tamed, and is sometimes employed in Constantinople and elsewhere to catch rats and mice. There are several other species confined to Africa, such as the Senegal genet (*Genetta senegalensis*), lighter in colour than the common genet, the fur marked with a long dark line along the spine, with a bold black patch on either side of the face. See plate at CARNIVORA.

GENEVA (French, *Genève*; German, *Genf*), a canton of Switzerland, bounded on the north by the canton of Vaud and the Lake of Geneva, and on the east, west, and south by the territories of France. In addition to the territory thus bounded, the communes of Celigny, Le Coudre, and Petit Bois, inclosed by Vaud, belonged to this canton, which is one of the smallest in the Swiss Confederation, the area being only 108 English square miles. The surface is nowhere mountainous, but is broken by several hills, none of which is more than 400 feet above the lake. The whole canton belongs to the basin of the Rhône, and the only streams of importance are that river and the Arve, which joins it a little below the town of Geneva, the capital of the canton. In the vicinity of these rivers the supply of water is ample, but in the upper districts it is deficient, and in summer considerable scarcity is felt. The climate is generally healthy, and rain is by no means frequent, the average annual quantity being only the half of that which falls on the Great St. Bernard. Winds are very common, both from the lake and the land. The most frequent and most violent are the north, here called the *bise* and the *vent*. Harvest is about a fortnight earlier than in the canton of Vaud. In geological structure the whole canton belongs to what is called the Molasse formation, consisting chiefly of a soft green sandstone. A great many boulders of a different formation are scattered over the surface, and garnets, jaspers, and other fine pebbles are often found. In the hills of Cologny and Dardagny some coal is worked. The soil of the canton is naturally less fertile than that of most of the adjoining districts, but has been so much improved by skilful and persevering culture that abundant crops of all kinds suitable to the climate are raised, and the whole territory wears the appearance of a large and beautiful garden. The natural flora is remarkably rich, and makes the country around Geneva a favourite resort of the botanist. Within a circle of 25 miles round the capital 1470 species of plants have been found. Part of the surface is under the culture of the vine, but the wine obtained is not remarkable either for quantity or quality. Wood is rather deficient. Manufactures are extensively carried on, and with a success which places the great body of the inhabitants in comfortable circumstances. They consist chiefly of clocks and watches, musical-boxes, mathematical instruments, gold, silver, and other metal wares, woollen cloths, and silk goods of various descriptions, hats, leather, and articles in leather; and there are numerous cotton-mills, printfields, and dye-works, foundries, machine-shops, breweries, &c. The territory of Geneva having, by the arrangements of the Congress of Vienna, obtained an accession of fifteen communes, detached from France and Savoy, was admitted a member of the Swiss Confederation in 1814, and ranks as the twenty-second canton. A constitution, somewhat aristocratical in its nature, was framed, and continued in force till 1830, when a considerable modification of it took place. In 1841, in consequence of a popular tumult, the original constitution was abandoned for one in which the democratic principle is completely predominant. This new constitution was modified under popular pressure in 1847. The legislative power is exercised by a great council, composed of deputies of twenty-five years of age, elected by all male citizens of twenty-one years of age not under legal incapacity. The number of deputies is at the rate of one for every 333 inhabitants, and amounts at present to 274. They are elected for four years, but one-half retires every second year. Those who retire may be immediatly re-elected. Every new law, or alteration of law, must be sanctioned by the great council. The executive is confided to a council of state consisting of thirteen members belonging to the great council, and appointed by it. The president and vice-president, also named by the great council, have the title of Syndics, and receive each a salary of £120. Each member of the council of state has a salary of about £96. All religious denominations are declared to have perfect freedom, but two of them are paid by the state—the Roman Catholics, amounting to rather more than a third of the population, and the Protestant National Church, many of whose members are understood to have departed widely from the system of theology which Calvin taught them, and to have adopted a modified species of Socinianism. The language spoken is French. Pop. (1897), 111,732.

GENEVA, a town of Switzerland, capital of the above canton, on the declivities of two hills, in the centre of a basin, the sides of which are formed partly by the lower slopes of the Jura, and partly by secondary chains of the Alps, at the western extremity of the Lake of Geneva, where it narrows almost to a point, and pours out the blue Rhône, here crossed by several bridges, and dividing the town into two portions, the larger and more important of which is on the left or south bank of the river. The environs are covered with handsome villas, and the town itself, when approached either by land or water, has a very imposing appearance. It was formerly surrounded by walls and regular fortifications, but since 1850 these have been

removed to make way for the extension of the town, which has been going on with great rapidity. The town is divided into two parts, an upper and a lower. The upper town, occupied chiefly by the wealthier citizens, contains a considerable number of well-built houses and handsome hotels; the lower town, the seat of trade and residence of the poorer classes, consists chiefly of narrow, irregular, dark, and ill-cleaned streets, but in this quarter great improvements have recently been carried out. Among the other improvements is the erection of a breakwater which gives shelter to the lake steam-boats; and the quay is bordered by a row of handsome modern houses. The more important public buildings are the cathedral or church of St. Pierre, a Gothic structure of the tenth, eleventh, and twelfth centuries, occupying the highest site in the town, and by its three towers forming the most conspicuous object within it, somewhat defaced externally by a very incongruous Greek peristyle; the town-house; the post-office (1892); the Musée Rath, a neat building, named after its founder, and containing a collection of pictures and other works of art; the Fol Museum, with a collection of antiquities; the arsenal, with a collection of ancient armour; the university, founded as an academy by Calvin in 1559, and rebuilt in 1867–71, containing the public library, founded by Bonnivard, the prisoner of Chillon, in which are 100,000 volumes, 500 MSS., and a collection of autograph letters by Calvin and other distinguished reformers; a splendid theatre, opened in 1879; the Museum of Natural History, enriched with the geological collections of Saussure, the Haller herbarium, and the fossil plants of Brongniart and Decandolle; the botanical garden, astronomical observatory, the old prison, originally the bishop's palace; the casino, penitentiary, hospital, and house of correction. The only important manufactures of Geneva are those of watches, musical boxes, and jewelry, for all of which the town is justly famed. Geneva has ample railway communication, and is visited annually by large numbers of tourists and travellers into Switzerland. In literature and science Geneva has long occupied a distinguished place. Education is very generally diffused, and the people as a whole are distinguished for intelligence. Geneva has been the birth-place or residence of such eminent men as Calvin, Beza, Knox, Le Sage, Necker, and Rousseau.

The origin of Geneva is unknown, but its antiquity is proved by the reference which Cæsar makes to it. On the invasion of the North it was successively occupied by the Burgundians, who made it their capital, the Ostrogoths, and Franks. It next formed part of the second kingdom of Burgundy, and became incorporated with the Germanic Empire. By a grant of the emperors the temporal was added to the spiritual power of the bishops, and the counts of Savoy, having succeeded in controlling the nomination of the bishop, became in a manner masters of Geneva. This state of matters was suddenly interrupted by the Reformation, the doctrines of which, boldly preached by Farel, met with ready acceptance. The adherents of the family of Savoy were expelled the city, and the bishopric declared vacant. In August, 1535, the reformed religion was established by law; and in 1541 Calvin was appointed public teacher of theology. He impressed the stamp of rigid morality on the minds of the people, and awakened a taste for the exact sciences. The town, hitherto a mere trading locality, thus acquired an important influence over the spiritual life of Europe, and became the centre of education for the Protestant youth of Britain, France, and Germany. During the eighteenth century Geneva was distracted by a continued feud between the aristocratic and popular parties, until in 1782 France, Bern, and Sardinia interfered in favour of the aristocrats. The French revolution led to a new crisis; the government was overthrown in July, 1794; a national convention was appointed, and a reign of terror commenced. In 1798 the city and its territory were annexed to France, under the name of the Department du Leman. After the downfall of Napoleon Geneva recovered its independence, and the Congress of Vienna increased its territory considerably. (See preceding article.) Pop. (1897), 86,535.

GENEVA, Lake of, or Leman (Latin, *Lacus Lemanus*), the largest of the Swiss lakes, surrounded north and west by canton Vaud, south-west by canton Geneva, south-east by canton Valais, and south by Savoy; length, measured on its north shore, 55 miles, and on its south shore 40 miles; central breadth, about 6 miles; area, 220 square miles; greatest depth, 900 feet. It is in the form of a crescent, with its horns turned south, and is 1150 feet above the sea. Its scenery, though grand, is surpassed by that of several of the Swiss lakes. On the north the shore is low, and the ground behind ascends gradually in beautiful slopes covered with vines. On the south, and particularly on the east side, the shore is rocky and abrupt, and lofty precipices often rise sheer from the water's edge. The numerous small boats on the lake, with their lateen-sails, add much to the picturesqueness of the scene, and the steamers afford excellent facilities for visiting all that is interesting on the shores of the lake or its immediate vicinity. A remarkable phenomenon in the lake is a sudden rise and fall, sometimes of 5 feet, but usually of only 2 feet, and never lasting more than twenty-five minutes. Owing to the depth of the lake it never freezes entirely, though in severe winters its lower extremity becomes covered with ice. It contains various species of fish, and its water is remarkably pure and of a beautiful blue colour. The Rhône, which enters it a muddy turbid stream, issues from its western extremity perfectly pellucid, and of the finest blue.

GENEVA CONVENTION, an agreement signed by delegates from various countries assembled at Geneva in 1864, directed towards lessening the horrors of war, and especially the succour of the sick and wounded in time of actual warfare. The international code adopted forbade the use of explosive bullets, and established the neutrality of hospitals and ambulances. A society was also formed called the Red Cross Society, the members of which succour the wounded under the protection of the badge of the society, a red cross on a white ground.

GENEVIÈVE.—1. St. Geneviève, the patron saint of Paris; born at Nanterre, about 5 miles from Paris, in the year 423, about the time of Pharamond, the first king of France. St. Germain, bishop of Auxerre, observing in her when yet very young a particular disposition to sanctity, advised her to take a vow of perpetual virginity, which she accordingly did in the presence of the Bishop of Paris. After the death of her parents she went to Paris. The city was about to be deserted when Attila with his Huns broke into France; but Geneviève assured the inhabitants of complete security if they would seek it by fervent prayers. Attila took his course from Champagne to Orleans, returned hence into Champagne without touching Paris, and was defeated in 451. By this event Geneviève's reputation was established. In a time of famine she went along the river Seine from city to city, and soon returned with twelve large vessels loaded with grain, which she distributed gratuitously among the sufferers. This increased her authority, and she was highly honoured by Mero-

vœus and Chilperic. Nothing, however, contributed more to her reputation for sanctity than the circumstance that, from her fifteenth to her fiftieth year she ate nothing but barley-bread, except that she took some beans every two or three weeks, and after her fiftieth year some fish and milk. In 460 she built a church over the graves of St. Dionysius, Rusticus, and Eleutherus, near the village of Chasteville, where Dagobert afterwards founded the abbey of St. Denis. She died about 512, and her remains were placed in the subterranean chapel which St. Denis had consecrated to the apostles Paul and Peter. Clovis by her request built a church over it, which was afterwards called by her name, as was also the abbey that was founded there. Another church, consecrated to this saint, was built near the church of Notre Dame. By a decree of the National Convention, 1791, this edifice was named the Panthéon, but its original name was restored officially in 1851. Her relics, which were preserved in the former till its destruction at the revolution, are now in the church of St. Étienne du Mont. Her fête is held on the 3d of January.

2. Another St. Geneviève, by birth Duchess of Brabant, wife of Siegfried, count palatine in the reign of Charles Martel (about 750). Being accused by her intendant Golo of adultery during her husband's absence, on his return she was condemned to death; but the vassal to whom her execution was intrusted allowed her to escape, and she lived six years in a cavern upon nothing but herbs. She was finally found, and carried home by her husband, who in the meantime had become convinced of her innocence. This legend is the subject of one of the finest and most perfect of the German popular tales, which appears to have been written by Dr. Matthias Emmich about 1472. The story has been retold by Tieck and Maler Müller, and dramatized by Raupach.

GENGIS (or GENGHIS) KHAN (*Zingis, Chingis Khan.*) This renowned conqueror was the son of a Mongol chieftain, by the name of Yezonkai, or Pyzukaï, whose jurisdiction extended over thirty or forty clans, but who at the same time paid tribute to the Tartar Khans, then bearing sway over Eastern Tartary and the north of China. Gengis Khan was born in the year of the Hegira 559, or A.D. 1163–64 (according to other authorities in 1155), at a place called Blun Yulduk, and received the name of Temudjyn. The talents of the youth were so well cultivated by his teacher, Karakhar, that at the early age of thirteen he was able to govern the domain which he inherited from his father. The heads of the tribes and families under his jurisdiction imagined it would be an easy matter to dispossess the stripling of his territory, or to withdraw themselves from his dominion. But he immediately led an army of 30,000 men in person against the rebels, and after one indecisive battle entirely vanquished them in a second, and rewarded his soldiers with the spoils, of which the prisoners, who were treated as slaves, made a part. Many of these, however, who were distinguished for their rank and influence, were plunged, by the conqueror's orders, into seventy vessels of boiling water. A great number of tribes now combined their forces against him. But he found a powerful protector in the great Khan of the Karaite Mongols, Oung, or Vang, who gave him his daughter in marriage. This occasioned a war with a discarded rival, who was overcome by the united forces of Gengis and Oung. Gengis at last incurred the suspicions of his father-in-law, owing to intrigues of envious courtiers, and orders were issued for his arrest. He succeeded, however, in making his escape to his own dominions with about 5000 cavalry.

In 1202 father and son formally declared war against each other, and Oung lost in battle more than 40,000 men, and was killed in his flight. The victor, however, found a new and more formidable adversary in Tayan, the chieftain of the Naiman Tartars. A battle was fought on the banks of the Amur (1203). Tayan was wounded, and died in the flight after seeing his soldiers cut down to the last man. This signal victory secured to the conqueror the dominion of a great part of the Mongol territory, and the possession of the capital, Kara-Korum. In the spring of the following year he held a sort of diet in Blun Yulduk, the land of his birth, where deputies assembled from all the hordes subject to him. This body conferred on him the crown, and proclaimed him *Khakan*, or *Great Khan*, in presence of the army. At the same time a devout Khaman, who was highly venerated by the Mongols, prophesied that he would reign over the whole earth, and commanded him to be called henceforth, not Temudjyn, but *Gengis Khan*. In the same assembly the emperor promulgated a military and civil code of laws, which is still known in Asia by the name of *Yza Gengis Khany*. This code is grounded on monotheism, though it is said that Gengis had no particular religious creed. All men of merit, whatever their faith might be, were welcome at his court. He also caused many books in various languages, such as the Thibetan, the Persian, and the Arabian, to be translated into the Mongol language, an example which was imitated by his successors, so that the Mongols soon took rank among the refined nations of Asia.

The prophecy at the coronation of the great Khan so animated the spirit of his soldiers that they were easily led on to new wars. The beautiful and extensive country of the Uigurs, in the centre of Tartary, had long excited his ambition. This nation, more distinguished for indolence and effeminacy than martial prowess, was easily subdued, and Gengis Khan was now master of the greatest part of Tartary. Soon after several Tartar tribes put themselves under his dominion, and in 1209 he passed the great wall and sent troops to Leatong and Petscheli. The conquest of China occupied the Mongols more than six years. The capital, then called *Yenking*, now *Peking*, was taken by storm in 1215 and plundered. The conflagration lasted a month. He at one time thought of putting to death all the natives of China, turning the cultivated fields into pastures, and making it the residence of a few men who would be incapable of attempting hostilities. But one of his counsellors, Tletchusay, strongly opposed the measure. The murder of the ambassadors whom Gengis Khan had sent to the King of Kharism (now Khiva) occasioned the invasion of Turkestan in 1218 with an army of 700,000 men. The first conflict was terrible but indecisive. The sons of Gengis Khan showed themselves worthy of their father. The Kharismans lost 160,000 men.

In 1219 the Mongols pushed their conquests still further. The two great cities of Bokhara and Samarcand made the greatest resistance. They were stormed, plundered, burned, and more than 200,000 men perished with them. Seven years in succession was the conqueror busy in the work of destruction, pillage, and subjugation, and extended his dominions to the banks of the Dnieper, defeating the Russians at Mariupol, where the Grand-duke of Kiew and the Duke of Tchernikoff were taken prisoners. The conqueror now resolved to return to his capital, Kara-Korum. Here his family came as far as the banks of the river Tula to meet him, and received him with the liveliest joy. Of his numerous grandchildren he caused two to be educated according to a system of his own. In 1225, though more than sixty years old, he marched in person at the head

of his whole army against the King of Tangut, who had given shelter to two of his enemies, and had refused to give them up. The Mongols marched through the desert of Gobi in winter into the heart of the enemy's country, where they were met by an army of 500,000 men. A great battle was fought on a plain of ice formed by the frozen Karamoran, in which the King of Tangut was totally defeated with the loss of 300,000 men. The victor remained some time in his newly-subdued provinces, from which he also sent two of his sons to complete the conquest of Northern China. Meantime the siege of the capital of Tangut, Nankin, was zealously prosecuted. The city at length yielded, and like the others was given up to fire and sword. But the foundation of a Mongol monarchy in China was reserved for his grandson.

On this expedition Gengis Khan felt his death approaching. He summoned his children together, enjoined union upon them, and gave them the wisest advice for the government of the extensive states which he left them, and which stretched 1200 leagues in length. He died, August 18, 1227. The ambition of this conqueror cost the human race from 5,000,000 to 6,000,000 of persons of every age and sex. Besides this, he destroyed a vast number of monuments of art and valuable manuscripts which were deposited in the cities of Balkh, Bokhara, Samarcand, Peking, and other places. He was interred with great pomp at Tangut, not far from the place where he died, under a tree remarkable for the enormous size of its branches. He had himself chosen this spot for his burial place. Before he died he divided his territories among the four princes whom he had by the first of his four legitimate wives. A great part of the empire of Gengis Khan, however, came into the hands of Kublai, who is considered as the founder of the Mongol dynasty in China. The only memorial of the conqueror now known to exist is a granite tablet discovered among the ruins of Nertschinsk. The inscription in Mongol has been deciphered by Schmidt of St. Petersburg. It had been erected by Gengis Khan in commemoration of his conquest of the Kingdom of Saratogal (better known as Karakitai).

GENII. See GENIUS.

GENISTA, a genus of leguminous plants, one of which is the *Planta genista*, the *Plante genêt*, from which the Plantagenets took their name. The most common native species are the *Genista tinctoria*, or dyer's broom, so called, as it was formerly much employed by dyers, who obtained a good fixed yellow or orange colour from it, or a green if it was mixed with woad; and the *G. Anglica*, or petty whin, found on poor heathy places, and said to be one of the indications of hungry bad land. The *genista* of Virgil and other Latin authors is supposed to be the *G. Hispanica*, a native of Southern Europe.

GENITIVE CASE (Latin, *genitivus*, literally generative, from a misunderstanding of the Greek term *hē genikē* (*ptōsis*), the *generic* case), in grammar, that case which often denotes possession, and hence so far corresponds with our possessive, but which also expresses various other relations. With Aristotle it is the predicating case which determined the genus to which a thing belonged; as such it had no reference to origin or birth. In English the genitive or possessive is the only case among nouns expressed by inflection, as *the king's prerogative*. It is often expressed by the preposition *of*, as *the prerogative of the king*. From the frequency with which the form in *'s* indicates that one thing belongs to another, it has been called the *possessive* case; but this name is scarcely applicable in such cases as a *day's work*., The *generic* case, however, meaning that which limits the other noun to a class or kind, will be found to express the real relation in every conceivable combination. The termination *s* has erroneously been supposed to be a contraction of his, as if the *boy's book* were equivalent to the *boy his book*. But this does not account for the *girl's book* and the *boys' books*. The termination is a relic of the inflections of the Anglo-Saxon, *s* being the prevalent ending of the genitive singular. In modern English it has been extended by analogy to all nouns, and even to the plural. The apostrophe is merely an arbitrary sign to distinguish the possessive from the plural.

GENIUS. The Genii of the Romans were the same as the *Daimones* (Demons) of the Greeks. According to the belief of the Romans (says Wieland), which was common to almost all nations, every person had his own Genius; that is, a spiritual being, which introduced him into life, accompanied him during the course of it, and again conducted him out of the world at the close of his career. The Genii of women were called *Junones*. Male servants swore by the Genius of their master, female ones by the Juno of their mistress, and the whole Roman Empire by the Genius of Augustus and of his successors. As the religion of the Greeks and Romans in general was connected with no distinct and settled system, their whole creed being indefinite, wavering, and arbitrary, so there was nothing determined on this subject; and every one, according to his pleasure, believed either in two Genii, a white and good one, to whom he was indebted for the favourable events of his life, and a black and evil one, to whom he ascribed all his misfortunes; or in but one, who, as Horace (Epistles, ii. 2) says, was black and white at the same time, and according to the behaviour of a man his friend or enemy. The stronger, more powerful, prudent, watchful, in short the more perfect a Genius was, and the greater the friendship which he entertained for the person under his protection and influence, the happier was the condition of that man, and the greater were his advantages over others. Thus, for instance, an Egyptian conjuror put Antony on his guard against his colleague and brother-in-law Octavius. 'Thy Genius,' said he, 'stands in fear of his. Though great by nature and courageous, yet as often as he approaches the Genius of that young man, he shrinks and becomes small and cowardly.' The belief of the ancients in Genii (for not only every man, but every being in nature, had a Genius) was no doubt a consequence of their idea of a divine spirit pervading the whole physical world. Whatever gave a thing duration, internal motion, growth, life, sensibility, and soul was, according to their opinion, a part of that common and universal spirit of nature; therefore Horace calls the Genius the *god of human nature*. He is not the man himself, but he is what renders every one an individual man. His individuality depends on the life of this man, and as soon as the latter dies the Genius is lost again in the universal ocean of spirit, from which at the birth of that man he emanated, in order to give to that portion of matter of which the man was to consist, an individual form, and to animate this new form. Horace, therefore, calls him *mortalem in unumquodque caput*. As the Greeks were accustomed to clothe all invisible things and all abstract ideas in beautiful human forms, the Genius of human nature also received a particular image. He was represented as a boy, or rather of an age between boyhood and youth, slightly dressed in a garment spangled with stars, and wearing a wreath of flowers or a branch of maple, or naked and with wings, like the Genius in the Villa Borghese, of whose beauty Winckelmann speaks with so much enthusiasm.

The Jinns of the East, commonly translated *Genii*,

seem to be the lineal descendants of the Devatas and Rakshasas of the Hindu mythology. They were never worshipped by the Arabs, nor considered as anything more than the agents of the Deity. Since the establishment of Mohammedanism, indeed, they have been described as invisible spirits; and their feats and deformities which figure in romance are as little believed by the Asiatics as the tales about King Arthur are by ourselves. They are supposed to be a class of intermediate beings between angels and men, created from fire, of a grosser fabric than the former, and more active and powerful than the latter. This semi-corporeal form they are capable of metamorphosing at pleasure. Some of them are good, others bad; and they are, like men, capable of future salvation or condemnation. Their existence as superhuman beings is indeed maintained by the Mussulman doctors, but that has little connection with their character and functions as delineated by the poets. In poetry they are described as the children and subjects of Jan ibn Jan, under whom, as their sole monarch, they possessed the world for 2000 years, till their disobedience called down the wrath of the Most High, and the angel Háris, or, according to others, Azazel, was sent to chastise and govern them. After completely routing Jan ibn Jan, Háris succeeded to his dignity; but, turning rebel himself, he was afterwards dethroned, and condemned to eternal punishment. From that period he was called Eblis or Iblis. The Afrits and Ghouls, hideous spectres, assuming various forms, frequenting ruins, woods, and wild, desolate places, and making men and other living beings their prey, are often confounded with the Jinns, or Divs, of Persian romance, though probably they are of Arabian origin, and only engrafted in later times on the mythological system of Persia and India.

GENIUS, in mental philosophy. From the ancient superstition, that to every human being was allotted a tutelary god or demon who introduced him into life, who presided over his fortunes and destiny, and who eventually led him out of existence, the most common meaning now attached to the word has arisen: that high mental endowment, that creative or inventive faculty, which is at once a law and model to itself and to the crowd of admiring imitators which follows in its track, that special intellectual capability which no training can give, and which it is the lot of but a very few to possess, and still fewer to transmit. Like everything else that is truly great and beautiful, genius has in it a something indefinable. Poet, philosopher, and physiologist have in turn offered us various theories, in all of which there is and must be something deficient. By Plato it is called a divinely-inspired madness; by a French wit, a sublime common sense; by Dr. Johnson, 'large general powers accidentally determined in some particular direction;' by Hegel it is defined as the general capacity of conceiving a true work of art, together with the energy necessary for realizing and executing it; by Latena, the highest power of the imagination, regulated by common sense and the sentiment of the beautiful — reason inspired, in short; and ever so many more definitions might be given. The more enlightened psychologists of the present day do not accept the Johnsonian theory, which has been endorsed by Carlyle, and which implies that the man of genius could be anything he pleased; that a Bacon could have been a Shakspeare, or Burns a Cromwell; an assumption somewhat improbable and verging on absurdity. There is a class of minds noted for versatility, but they are the select of a select class; Cæsar was a general, orator, author, and statesman; Michael Angelo was equally celebrated as a statuary, architect, and painter. But the tendency now is to consider human beings as born with distinctive endowments, and although there is a common mental organization at the basis, yet this is supposed to have a plurality of distinct functions, any one of which may rise in degree without the rest. Thus intellect may be powerful on the whole without involving a proportionate intensity of emotion or volition; the sensibility of the ear may be acute while that of the eye is only average. It is therefore natural to suppose that genius in any one line would result from the extraordinary augmentation of the susceptibilities and powers that require to be specially exerted in that line. We would thus expect to find in the painter a keen sense of colour and form, skill of hand, and a vivid recollection of those objects of nature and human life that are the fitting materials of a painter's compositions; in the musician an acute sense of time and tune, and the power of suggesting a train of ideas by a succession or combination of sounds, which is the special property of his art. In this way, by a kind of analysis, we might determine what special faculty would have to be exalted to its intensest pitch to produce a genius in each separate walk. This is the method adopted even by adherents of radically opposed schools of psychology. Consult Bain On the Study of Character; Galton's Hereditary Genius; &c.

GENLIS, Stéphanie Félicité Ducrest de St. Aubin, Countess de. This prolific and popular authoress was born near Autun, in 1746. Mlle. de St. Aubin was celebrated for her beauty and musical talents, and favourably received in the most distinguished families. She had thus an opportunity of cultivating her mind and improving her knowledge of the world. Count de Genlis, who had never seen her, but had read a letter of hers, was so enraptured with the style in which it was written, that he offered her his hand when she was but fifteen years old. The countess, who was the niece of Madame de Montesson (who had been privately married to the Duc d'Orléans), obtained through her influence the place of lady-in-waiting to the Duchesse de Chartres. In 1782 the Duc de Chartres (Philippe Égalité) appointed her governess of his children. Her duties induced her to write the Théâtre d'Éducation (1779), Adèle et Théodore (1782), the Veillées du Château (1784), and the Annales de la Vertu (1783) —works on education, to which the reputation and station of the authoress attracted general attention. She conducted the education of the children entirely herself, taking part at the same time in the other affairs of the house of Orleans. It appears from her writings that she was favourably disposed towards the revolution; that she had received Pétion and Barrère in her house, and had been present in the sessions of the Jacobins. She, however, left France as early as 1791. She relates herself in her Précis de ma Conduite, that Pétion conducted her to London that she might meet with no obstructions to her journey. About the time of the September massacres (1792) the Duke of Orleans recalled her to Paris. As the governess of the children, and the friend and confidant of the father, she had become suspected. She therefore retired to Tournay, where she married her adopted or natural daughter, the beautiful Pamela, to Lord Edward Fitzgerald. Here she saw General Dumouriez, and followed him to St. Amand. Not approving of the plan of the general (who had the sons of the Duke of Orleans with him), to march to Paris and overthrow the republic, she retired with the princess to Switzerland, in April, 1793, where she lived in a convent at Bremgarten, a few miles from Zürich. The daughter of the Duke of Orleans having then gone to join her aunt, the Princess of Condé, at Friburg, Madame de Genlis retired with her foster-daughter, Henriette

Sercy, who was now alone left to her, to Altona, in 1794, where, in monastic solitude, she devoted herself entirely to literature. At a country seat in the territory of Holstein she wrote the Chevaliers du Cygne (Hamburg, 1795)—a novel which contains many republican expressions, and very free descriptions. It appeared in 1805, in Paris, with many alterations. In 1795 she published Précis de la Conduite de Madame de Genlis. At the end of this work there is a letter to her eldest pupil (Louis Philippe) subjoined, in which she exhorts him not to accept the crown if ever it should be offered to him, because the French Republic seemed to rest upon moral and just foundations. When Bonaparte was placed at the head of the government she returned to France, and received from him a house, and in 1805 a pension of 10,000 francs. Her numerous works (upwards of ninety volumes), among which the Théâtre d'Education, Mademoiselle de Clermont, and Madame de la Vallière, appear to be the best, are distinguished by their pleasing style. Most of the works of Madame de Genlis belong to the class of historical novels. She died in December, 1830. For further information see the Mémoires Inédits de Mad. la Comt. de Genlis, sur le 18me Siècle et la Révolution Française, depuis 1756 jusqu'à nos Jours (Paris, 1825, eight volumes).

GENNESARET, Sea of, called also in the New Testament the Sea of Galilee and the Lake of Tiberias, in the Old the Sea of Chinnereth, from a town of that name on its shores; the modern name is *Bahr Tabaryeh*. It is the second of the three lakes into which the Jordan flows; is 13 miles long, and 5 or 6 broad, and is about 680 feet lower than the level of the Mediterranean. It is of an oval shape, and like almost all lakes of volcanic origin, occupies the bottom of a great basin, the sides of which shelve down with a uniform slope from the surrounding plateaux. On the east the banks are nearly 2000 feet high, destitute of verdure and foliage, deeply furrowed by ravines, but quite flat along the summit. The scenery is rather bleak and monotonous; the cliffs and rocks along the shores are of a hard porous basalt, and the whole basin has a scathed volcanic look. Yet this region was at the beginning of the Christian era the most densely populated in all Palestine. There were not less than nine cities standing on the shores of the lake, among which was Capernaum, Christ's 'own city.' Seven of these cities are now uninhabited ruins; one, Magdala, is occupied by half a dozen mud hovels; and Tiberias alone retains a miserable remnant of its former prosperity. The water of the lake is sweet, cool, and transparent, and as the beach is everywhere covered with pebbles, it has a bright sparkling look; a fact somewhat strange when we consider that the Jordan runs into it red and turbid, and that many brackish springs find their way thither. The lake still abounds in fish, but the fishery, as well as the cultivation of the surrounding country, is almost entirely neglected.

GENOA (Italian, *Genova* or *Genua;* French, *Gênes*), a city, Italy, Piedmont, capital of the province of the same name, on the coast of the Mediterranean, between two rivers, the Bisagno and the Polcevera, at the head of the gulf of the same name, 75 miles S.E. of Turin. The appearance of the city from the sea is beautiful and striking; it is in the form of a crescent, and rises gradually from the shore —the whiteness of the houses, the imposing outlines of the intermingling palaces, and the distant villas and gardens, heightening the effect of its picturesque position. Immediately behind the city rises an abrupt hill, covered with villas and country houses. The city is inclosed by extensive fortifications, which have recently been greatly strengthened. A broad rampart extends round the city in a semicircle, which measures about 10 miles, and the surrounding heights are crowned by ten forts, supported by redoubts and earthworks. In the older parts of the town the streets are extremely narrow, being seldom more than 10 feet wide, with lofty buildings on either side. They are also dark, steep, and crooked, and almost wholly inaccessible to carriages. In the newer quarters, again, many of them are spacious, and are lined with noble edifices. The finest of these streets are the Strada Nuova and the Strada Balbi, in both of which are a number of palaces of the most superb architecture, though often deformed by tawdry paintings on their fronts. Most of the streets, which are kept remarkably clean, are paved with smooth slabs of lava, having a pathway of bricks in the centre to afford footing to mules, and to persons carrying burdens. Many of the palaces are crowded with works of art by the greatest masters, and splendidly fitted up inside, though in a showy rather than a substantial manner. The principal palaces are—the Ducal palace (now containing the law-courts and various public offices), the Palazzo del Municipio or townhall, the Palazzo Brignole or Rosso (with the largest picture-gallery in Genoa), the Palazzo Pallavicini, and the palaces of Doria, Serra, Cambiaso, Balbi, and Durazzo. In the Piazza Acquaverde a statue of Columbus has been erected. The most remarkable of the churches is the Duomo, or Cathedral of St. Lorenzo, founded in the eleventh century, but not completed till the beginning of the twelfth, and exhibiting three distinct styles, the Romanesque, the French Gothic, and the Renaissance. The most conspicuous church in the general view of the city is that of Santa Maria in Carignano, finely situated on a hill, and having a resemblance to St. Peter's in its general plan. The other churches of note are, St. Stefano della Porta, a handsome structure, but chiefly remarkable for containing a painting of the martyrdom of the titular saint, the joint production of Raphael and Giulio Romano; San Siro (St. Cyr), the most ancient Christian foundation in Genoa; Saint Ambrosia, containing several fine paintings, and splendidly decorated within; L'Annunciata, also magnificently fitted up interiorly. The Accademia delle Belle Arti contains mediæval sculptures from the suppressed church of San Dominico, a library with about 40,000 vols., and a picture-gallery. The principal charitable institution is the Albergo de' Poveri, in which 1600 individuals, orphans and old people, find shelter, and the children are brought up to different trades. The Ospedale del Pammatone is another splendid institution for benevolent purposes, founded in 1430. The deaf and dumb institution (Sordi Mutti) is also much celebrated. Among the theatres of the city may be mentioned the Teatro Carlo Felice, an elegant structure, with a splendidly fitted up interior. Besides the university, which has a library and a natural history museum, the other chief educational institutions are the theological seminary, the school of fine arts, the royal marine school, and the navigation school. Genoa is the seat of royal appeal courts, of a chamber of commerce, and an admiralty court. It is supplied with water by aqueducts 18 miles in length. The Campo Santo, about 2½ miles from the city, is one of the most beautiful places of sepulture in Europe.

The manufactures of Genoa are considerable. Its velvets and silk are world-famed; and it likewise possesses factories of cloth, stockings, blonde, oil-cloth, hats, paper, essences, and soap. Besides these, its works in gold, silver, and marble have a high reputation; indeed, for silver filagree, delicately and artistically wrought into bracelets, brooches, bunches

of flowers, and other kinds of ornaments innumerable, the Genoese workmen stand unrivalled, and their productions are sent to all parts of the world.

The harbour accommodation of Genoa is now extensive. The inner harbour, which is of a semicircular form and about ¾ of a mile in diameter, is entered between two moles projecting into the sea from opposite sides, and overlapping each other—the Molo Nuovo, or New Mole (with a lighthouse visible for nearly 20 miles), being about 790 yards south of the Molo Vecchio, or Old Mole. Between these two moles is the Porto Nuovo or new harbour, outside of which other large moles have been constructed to form the Avamporto or outer harbour. Connected with the harbour are graving-docks and other works. There is also a naval harbour and a marine arsenal. Genoa is a free port, in which goods may be warehoused, and from which they may be re-exported free of duty. It is the chief outlet by the Mediterranean for the manufactures of Switzerland, Lombardy, and Piedmont, and is of great importance as a receiving port for North Italy and Switzerland. It is also a distributing port for the products of Southern Italy. There is an immense number of bonding warehouses situated in one locality, called Porto Franco; these are surrounded by walls, and form a small separate town. The principal articles of export are wine, silk, oils, matches, fruit, cheese, straw and other hats, coral, tanned hides, the products of its manufactures, &c. Imports—cottons, raw cotton, wheat, coal, hides, chemicals, colours, and dyes, colonial produce, tobacco, salt-fish, iron, machinery, &c. The coal comes mostly from the United Kingdom, especially from Wales. In the middle ages the Genoese merchants were remarkable for their commercial enterprise. Their commerce subsequently declined greatly, but has been for some years steadily increasing. The shipping entered in the foreign trade in 1902 had a total burden of 5,537,996 tons. The value of the imports was £20,572,000; of the exports, £9,082,000. The number of emigrants from Genoa was 62,266 in 1902, the chief destinations being North America, Buenos Ayres, Brazil, &c.

The history of Genoa may be traced back in legendary traditions to a time preceding the foundation of Rome. It was one of the most considerable cities of the Ligurians, and is mentioned by Livy (under the name of *Genua*) as being in friendly relations with Rome at the beginning of the second Punic war. It was subdued and partly destroyed during that war by a Carthaginian fleet under the command of Mago. The Romans rebuilt it, and it afterwards became a Roman *municipium*. After the decline of the Roman Empire in the West it fell into the hands of the Lombards, and with them became subject to the Franks. After the downfall of the empire of Charlemagne, Genoa erected itself into a republic, and till the eleventh century shared the fortunes of the cities of Lombardy. The situation of the city was favourable to commerce, and it pursued the trade of the Levant even earlier than Venice. The acquisitions of the Genoese on the Continent gave rise, as early as the beginning of the twelfth century, to violent contentions with the enterprising and industrious merchants and tradesmen of Pisa, who became their near neighbours after Genoa had made itself master of the Gulf of Spezzia. In 1174 Genoa possessed Montferrat, Monaco, Nice, Marseilles, almost the whole coast of Provence, and the island of Corsica. The quarrel with the Pisans continued above 200 years, and peace was not concluded until Genoa had destroyed the harbour of Pisa and conquered the island of Elba. Not less violent was the contest with Venice, which was first terminated in 1282 by the Peace of Turin. As it was the dominion over the western part of the Mediterranean which formed the subject of dispute with Pisa, so in the war with Venice it was contended which should possess the eastern portion of that sea.

The Genoese made commercial treaties with the different nations of the Levant. Their superiority in trade was at its highest point at the time of the revival of the Græco-Byzantine Empire, about the middle of the thirteenth century. Long before, the inactivity of Constantinople had allowed the Genoese to obtain a large share in the commerce of the Grecian states. But when the Genoese took possession of the town of Kaffa, now Feodosia, in the Crimea (1266), they also acquired the control of the Black Sea and its trade. If Genoa had adopted a wise colonial system she would have held the first rank among the commercial nations at the end of the middle ages. After the conquest of Constantinople by Mohammed II. in 1453 the Genoese soon suffered for the aid they had imprudently afforded the Turks. Mohammed took from them their settlements on the Black Sea in 1475, and at length all access to this branch of trade was denied them by the Turks.

While the power and commercial rank of Genoa were attaining their height by means of their foreign trade and acquisitions of territory the city was internally convulsed by civil discord and party spirit. The hostility of the democrats and aristocrats, and the different parties among the latter, occasioned continual disorders. In 1339 a chief magistrate, the doge, was elected for life by the people; but he had not sufficient influence to reconcile the contending parties. A council was appointed to aid him; yet, after all attempts to restore order to the state, there was no internal tranquillity; indeed, the city sometimes submitted to a foreign yoke in order to get rid of the disastrous anarchy which the conflict of parties produced. In the midst of this confusion St. George's Bank (*Compera di S. Giorgio*) was founded. It owed its origin to the loans furnished by the wealthy citizens to the state, and was conscientiously supported by the alternately dominant parties.

In 1528 the disturbed state regained tranquillity and order, which lasted till the end of the eighteenth century. The form of government established was a strict aristocracy. The doge was elected to be the head of the state. He was required to be fifty years of age, and to reside in the palace of the republic (*palazzo della signoria*), where also the senate held their meetings. The doge had the right of proposing all laws in the senate. Without his acquiescence the senate could pass no decree; and the orders of the government were issued in his name. He continued in office two years, after which he became a senator and procurator, and at the expiration of five years was again eligible to the office of chief magistrate. The doge was assisted in the administration of the government by twelve governors and eight procurators (not counting such as had previously held the office of doge), who likewise retained their office two years. They constituted the privy-council, who, with the doge, had charge of all state affairs. The procurators had charge of the public treasury and state revenue. The sovereignty was possessed, in the first instance, by the great council, composed of 300 members, among whom were all the Genoese nobles who had reached the age of twenty-two years. Secondly, by the smaller council, consisting of 100 members. Both had a right to deliberate with the governors and procurators upon laws, customs, levies, and taxes, in which cases the majority of votes decided. It belonged to the smaller council to negotiate respecting war and peace, and

foreign alliances; and the consent of four-fifths, at least, of the members was required for passing a law. The nobility were divided into two classes—the old and new. To the old belonged, besides the families of Grimaldi, Fieschi, Doria, Spinola, twenty-four others, who stood nearest them in age, wealth, and consequence. The new nobility comprised 437 families. The doge might be taken from the old or new nobles.

By little and little Genoa lost all her foreign possessions. Corsica, the last of all, revolted in 1730, and was ceded in 1768 to France. When the neighbouring countries submitted to the French in 1797 the neutrality which the republic had strictly observed did not save the fluctuating government from ruin. Bonaparte gave them a new constitution, formed upon the principles of the French representative system. Two years afterwards a portion of the Genoese territory fell into the hands of the Austrians; but the fate of Genoa was decided by the battle of Marengo. A provisional government was established, and in 1802 it received a new constitution as the Ligurian Republic. The doge was assisted by twenty-nine senators and a council of seventy-two members. The members of the council were elected by three colleges, and consisted of 300 landed proprietors, 200 merchants, and 100 men of the literary professions. The republic also acquired some increase of territory, and had in 1804 a population exceeding 600,000. Its naval force, which was so formidable in the middle ages, at last dwindled down to only a few galleys and barques; the land force became almost equally insignificant. The shipping trade in June, 1805, when the republic was incorporated with the French Empire, was but the shadow of its former greatness, and extended no further than to Italy, the south of France, Spain, and Portugal.

Before the Napoleonic wars the Genoese supplied a great part of Italy with eastern spices, which were brought to them by the Dutch; with sugar and coffee, partly from Lisbon and partly from Marseilles; and with fish and salt. Ships from Hamburg brought Saxon linen and cloth. The carrying trade of Genoa was of consequence, but the most important branch of its business was its dealings in money and exchange. Many of the European states, Spain particularly, were debtors to the Bank of Genoa, and to wealthy individuals in the city. The bank was in part for loans, and partly for deposit. It possessed some fine territories, and its income was over 10,000,000 of French livres. But the more frequently the state sought relief from the bank in its pressing wants, so much the more did it decline in credit. The republic had pledged various imposts for the payment of the interest upon capital borrowed from the bank, which were continually increased if they were not sufficient to pay it. At the union of Genoa with the French Empire the bank was abolished, and its debts were transferred to the account-books of France.

Upon the overthrow of the French Empire Genoa was occupied by the British, with whose permission the ancient constitution was re-established. But the Congress of Vienna, in 1815, assigned Genoa, with its territories, to Sardinia, stipulating that it should have a sort of representative constitution. In 1821 it joined for a moment the revolutionary movements of Italy. In the spring of 1849, after the defeat of Charles Albert at Novara, and the conclusion of a truce with the Austrians, a revolutionary outbreak took place, the national guards occupied the forts, and the garrison was compelled to withdraw. A provisional government was formed, and the independence of the republic was proclaimed. But a large body of Sardinian troops, under General Della Marmora, soon appeared before the city; a bloody struggle ensued, and the forts and principal points of the city were taken by the royal soldiery. Meanwhile a deputation was sent to Turin, which returned with the amnesty of the king, excluding the chief leaders of the movement, who, however, escaped on board an American vessel. In April the city was disarmed and the monarchical government restored. Following the fortunes of the Sardinian States Genoa became a portion of the Kingdom of Italy. Pop. (1898), 221,589; (1902), 228,202.

GENOA, GULF OF, a large indentation of the Mediterranean, in North Italy, north of the island of Corsica, at the west base of the Italian peninsula, at the head of which lies the city and port of Genoa. Opening widely and imperceptibly from the main body of the Mediterranean, no precise points can be named as marking its entrance; but it may, perhaps, be generally said to comprise the entire space north of lat. 43° 40′ N. Its shores are not very deeply indented, nor do they exhibit any very marked projections—the Gulf of Spezzia being the most remarkable of the former, and Capes de la Mele, Chiapa, and Venere the most noted of the latter.

GENRE-PAINTING, a term derived from the French *genre* (sort or kind), and which was originally employed to designate pictures of which the subjects were copied directly from nature, such as landscapes, scenes of every-day life, animals, fruit, and even portraits; in contradistinction to those which were more the product of the imagination, such as historical, religious, and purely ideal paintings. The term is now restricted to denote scenes of every-day life, such as Hogarth and Wilkie loved to depict. A genre-painter is not confined to low subjects, nor need his paintings be vulgar in the ordinary acceptation of the word, though the great modern masters in this style, the Dutch, have owed their inspiration and fame to scenes of very humble and often coarse life. This style of painting was not unknown to the ancients. Pyreicus, a Greek painter of the time of Alexander the Great, painted barbers' shops, cobblers' stalls, and the like, and according to Pliny, his pictures were highly prized. In Italy the painters who have worked in this style are Caravaggio, Manfredi, Salvator Rosa, Benedetto Castiglione, &c. But the art received its highest development in the Netherlands; Teniers the younger, Jan Van Mill, D. Ryckaest, Rembrandt, Nicolas Maas, Gerard Dow, Jan Steen, the Van Ostades, Brauwer, and Bega, are among the best exponents of the style. In Spain the most notable genre-painters are Velazquez and Murillo; and in Great Britain, after Hogarth and Wilkie, already mentioned, come Leslie, Mulready, Maclise, Egg, Millais, Faed, and others. The British school has sought to lend a dignity to the style by the introduction of the dramatic element. See PAINTING.

GENS, in Roman history, a clan or sect, forming a subdivision of the people next in order to the *curia* or tribe. The members and houses (*familiæ*) composing one of these clans were not necessarily united by ties of blood, but were originally brought together by a political distribution of the citizens, and bound by religious rites and a common name derived generally from some famous hero. This common name, which distinguished the *gentiles* or members of the same clan, was the second of the three borne by a Roman citizen.

GENSANO, or GENZANO, a town, Italy, picturesquely situated in the Campagna di Roma, 19 miles south-east of Rome. It has several straight and spacious streets, terminating in a handsome square with a beautiful fountain; and has a celebrated festival called the Infiorato di Genzano, when the streets are strewn with flowers and the town crowded with visitors. Its most conspicuous objects are the feudal

castle of the Dukes of Cæsarena and a Capuchin convent, both situated on an adjoining hill. In the vicinity is the Lake of Nemi, the classical Lacus Nemorensis. Pop. 5000.

GENS D'ARMES. See GENDARMES.

GENSERIC, King of the Vandals, was the bastard son of Godigisdus, and having obtained joint possession of the throne of Spain with his brother Gonderic, crossed the Straits of Gibraltar with 50,000 men, A.D. 429, on the invitation of Bonifacius, governor of Valentinian III., to assist him against the Moors. He, however, soon declared his independence, and, having completely defeated Bonifacius, founded a kingdom, which, in 439, had its seat at Carthage. Under Genseric the Vandals first became formidable at sea, and gained possession of parts of the islands of Sicily, Sardinia, and Corsica. In 455, on the invitation of the Empress Eudoxia, Valentinian's widow, who sought his assistance against Maximus, he landed at Ostia and marched to Rome, which he stormed and gave up to pillage for fourteen days. On his departure, in addition to his other plunder, he carried off numerous captives, including the empress herself and her two daughters, one of whom he married to his son Hunnerich. A fleet fitted out in 461 by the Emperor Majorian, with a view to suppress the Vandal piracies, was destroyed in the Bay of Carthagena. Another fleet fitted out for the same purpose by the Emperor Leo, in 468, was equally unsuccessful, having been burned off Bona. Genseric attained a great age, secured all his conquests, and, notwithstanding all his cruelties, was permitted to die in peace A.D. 477.

GENTIAN, a genus of plants, belonging to the natural order Gentianaceæ, including about a hundred species, many of them remarkable for the beauty of their flowers. As a general rule, flowers are divided by De Candolle into two series—1, those having *yellow* for their type, and which are capable of passing into red and white, and never into *blue;* and 2, those having *blue* for their type, and capable of passing into red and white, but never into yellow. The genus *Gentiana* belongs to the *blue* series; but there is a notable exception to the general rule in the *G. lutea*, which, as its name imports, is *yellow*. Most of the species inhabit the northern regions of the globe, or the tops of the highest mountains, particularly of the European Alps. The Andes of South America and Mexico afford fifteen species, and one has been discovered in Australia; ten species inhabit the United States of North America. The officinal gentian is the dried root of the *G. lutea* of the Alps, which has an intensely bitter taste, and is frequently employed as a tonic; indeed, as a febrifuge, its virtues have been celebrated from antiquity, and it was in common use in intermittents before the discovery of chinchona. The other species of gentian posses similar properties in a greater or less degree. The *G. crinita* produces one of the most beautiful flowers in North America; it is large, and of a beautiful blue colour. Several species are natives of the British Islands, *G. Pneumonanthe* being the handsomest, having a bright blue corolla 1½ in. long. *G. nivalis* and *G. verna* are small, but have brilliant blue flowers.

GENTIAN ROOT, COMPOSITION OF. Gentian root has been often analyzed, and various proximate principles have been separated from it. The more important are a volatile and a green oil; pectin, a sugar, gum, woody fibre, yellow colouring matter, gentianin or gentianic acid, and gentian-bitter. The oil is separated by distillation with water; it is buttery, lighter than water, is soluble in alcohol, and has a strong odour of gentian. *Gentianin* or *gentianic acid* ($C_{14}H_{10}O_5$) is got from residue of the aqueous infusion of the root by extracting with alcohol, evaporating, adding water and purifying the precipitated flakes of acid from oil and bitter resin by treatment with ether and repeated crystallizations from alcohol. The acid forms fine needles with no taste and a slight yellow colour. They are somewhat soluble in water, readily in ether and hot alcohol. The solutions have no acid reaction, but decompose alkaline carbonates. The gentianates of the alkalies, alkaline earths, and lead are yellow, of copper green, and of iron brown. The acid is tolerably stable, and can be sublimed. It is acted on by nitric acid; the nitro-acid formed gives a fine red colour with alkalies. Gentianin, even in large quantity, seems to be without any important physiological effect.

Gentian-bitter ($C_{20}H_{30}O_{12}$) can be got from the aqueous extract by animal charcoal, and then by dissolving the bitter out of the charcoal with strong boiling alcohol. The solution is concentrated, mixed with water to remove resin, oxide of lead added, and the filtrate after the lead is removed yields on evaporation and contact with ether a crystalline mass. The bitter forms colourless needles disposed in stars or grains; it has a strong and purely bitter taste. It dissolves readily in water and dilute spirit, not in ether, and with difficulty in strong spirit. It dissolves in alkalies; strong sulphuric acid turns it red on heating. The bitter principle is a glucoside. On treatment with weak acids it splits into glucose and *gentiogenin*, a brown amorphous powder insoluble in water, and of a bitter taste. Gentian-bitter is the active principle which makes the root of value as a tonic. The medicinal preparations of gentian are the *extract*, which is the aqueous infusion strained and evaporated to a paste for making into pills; the *compound infusion*, which contains in addition orange and lemon peel; the *compound tincture*, made by extracting gentian, bitter orange-peel, and cardamoms with alcohol; the *mixture*, which is a weak tincture containing bitter orange-peel and coriander; and *wine of gentian*, made from the powdered root, bitter orange-peel, yellow bark, and canella, with proof spirit and sherry. This last must not be confounded with a Swiss drink called gentian spirit, which is got from the aqueous infusion by allowing the sugar of the plant to undergo fermentation.

GENTILES (Latin, *gentilis*, from *gens*, nation). The Jews designated all who were not of the same nationality and faith as themselves indiscriminately as *the nations*, in Greek *ta ethnē;* and hence the Greek word *ethnikoi*, and its Latin equivalent *gentiles*, in the first century of the Christian era, began to be used to signify Pagans in opposition to Jews and Christians. The court of the Gentiles in the temple was the outer space, marked off by a wall or balustrade breast-high, within which strangers were forbiddden to enter, though they might come as far as the barrier to present their offerings. This explains the meaning of Paul (who is called the apostle of the Gentiles), when he speaks of 'the middle wall of partition' between Jew and Gentile as being broken down by the gospel.

GENTLEMAN. The English word *gentle* in its original sense signified one belonging to a race or family (Latin, *gens*). The law-books say that, under the denomination of *gentlemen* are comprised all above yeomen; so that noblemen are truly called *gentlemen;* and further, that a *gentleman* in England is generally defined to be one who, without any title, bears a coat of arms, or whose ancestors have been freemen: the coat determines whether he is or is not descended from others of the same name. In Blackstone's table of the rules of precedence in England, we find, after the nobility and certain official dignities, that doctors, esquires, gentlemen, yeomen, tradesmen, artificers, labourers, take rank in the

order in which we have named them. But the word corresponding to *gentleman* has in no language received so much of a moral signification as in England. The reason of this seems to us to be that aristocracy has nowhere taken the lead, in all matters of life, so much as in England, and that, therefore, the word *gentleman* soon came to signify a man that does what is proper, becoming, and behaves like a person of the higher, namely, well-bred classes.

Gentleman, in its highest sense, signifies a person who not only does what is right and just, but whose conduct is guided by a true principle of honour, that honour which does not consist in observing fashionable punctilios, but springs from that self-respect and intellectual refinement which manifest themselves in easy and free, yet delicate manners. To be truly a gentleman in feeling and manners is an object of great importance; and many well meaning persons, in the education of the young, forget to awaken early enough the sense of honour and self-respect, which is one of the best guards against all meanness of conduct.

GENTLEMEN-AT-ARMS, a body of forty gentlemen, headed by a captain, lieutenant, and standard-bearer, whose duties are to form a body-guard to the British sovereign on state occasions. The corps was established by Henry VIII. in 1509, under the name of the Band of Gentlemen Pensioners, and, with the exception of the yeomen of the guard, is the oldest in the British service. It consisted entirely of men of noble blood, and was called *His Majesty's Honourable Corps of Gentlemen-at-Arms* by William IV., in 1834, and is now recruited entirely from retired army officers. The appointment is in the sole gift of the crown, on the recommendation of the commander-in-chief, and the pay is issued from the privy purse.

GENTOO, a name formerly applied by English writers to the Hindus, but now obsolete.

GENTZ, Friedrich Von, a German diplomatist and publicist, born at Breslau in 1764, studied at Frankfort and Königsberg. He was secretary to the directory of finances at Berlin when the French revolution broke out, of which he was an ardent opponent. In 1792 he translated into German Burke's famous pamphlet on it, and added a series of violent notes. In 1802 he passed into the Austrian service, and after having been sent to England to negotiate an alliance drew up the Austrian manifesto of 1805. After the Peace of Presburg he returned to Berlin, and after the disaster of Jena, retired again to Vienna, where he composed the eloquent manifesto of 1809. He took part in the conferences of Vienna, and assisted in drawing up the treaty of the Italian alliance. He died in 1832. A selection from his various works, comprising political questions, a life of Mary Queen of Scots, and numerous articles, written for the Journal Historique, was published in 1838. In literature he sympathized with the German romantic school, and in politics defended absolutism.

GENUFLEXION (from the Latin *genu*, knee, and *flectere*, to bend), the act of bending the knees in worship. There are frequent allusions to genuflexion in the Old and New Testaments, and that the use was continued among the early Christians is evident from the Shepherd of Hermas, from the History of Eusebius, and other numerous authorities. As early as the age of Tertullian the practice of kneeling during prayer was discontinued throughout the Easter time, and on all Sundays through the year. Genuflexion obtains, both by rule and prescription, in various places in the offices of the Roman Church, and at different parts of the services of the Church of England, and this, together with bowing the head at the name of Jesus, was the subject of much discussion with the Puritans.

GENUS, in natural history, the term applied to a group of species (see Species) classed together by possessing certain important characters in common. Genera again are united to form families, families to form orders, and so on. See Generic Name and Generalization.

GEOCENTRIC, a term used in astronomy, in speaking of motion of the heavenly bodies with reference to the earth's centre. The apparent motion of the moon, to an observer at the earth's surface, is very sensibly different from what it would be if it could be observed from the centre of the earth. A correction must be applied for this reason to observed motion. Again, with respect to the other heavenly bodies, the motion is called *geocentric* when they are referred to the centre of the earth, and *heliocentric* when it is calculated with respect to the centre of the sun as the point of reference.

GEOCRONITE, a sulphantimonite of lead, containing arsenic, copper, and iron, is found in Ireland at Kilbricken, Clare county, and in Spain, Italy, and Sweden. It is usually in masses of a leaden colour and metallic lustre, but also occurs in rhombic crystals. Specific gravity, 6·4 to 6·6.

GEOCYCLIC MACHINE, a machine intended to represent in what manner the changes of the seasons, the increase and decrease of the days, &c., are caused by the inclination of the axis of the earth to the plane of the ecliptic at an angle of 66½°, and how the axis, by remaining parallel to itself in all points of its path round the sun, invariably preserves this inclination.

GEODES, round hollow nodules, containing sometimes earthy matters, sometimes a deposit of agate, sometimes quartz and spars crystallized. They are found in different geological formations.

GEODESY, that department of practical geometry that is concerned with measuring large tracts of the earth's surface, and, by comparing these measurements with the results of proper astronomical observations, inferring the figure of the earth. The physical difficulties that beset the carrying out of geodetical measurements are of the most formidable nature. To lay out a straight line by means of measuring rods, for example, to measure in a straight line from north to south, and to be sure that the rods used are always laid exactly in the direction fixed on, is a matter of the greatest difficulty. On the other hand, to measure with the assistance of a long chain, making sure that during the measurements the chain is not overstretched and that none of the links are jammed or catching at wrong points, is but little easier. Again, the expansion or contraction with the temperature of the measuring rods or chains has to be taken into account with great nicety. But were all these difficulties overcome, the difficulty of finding a suitable place for making geodetic measurements still remains. A plain intersected with streams, mountains, or valleys, is not suitable. To estimate with sufficient accuracy the undulations even of moderately level country is almost impossible; and, on the whole, it may be said that geodesy is the most difficult problem in engineering. See Ordnance Survey.

GEOFFREY OF MONMOUTH (called also *Geoffrey ap Arthur*), an ecclesiastic and historian of the twelfth century. According to Leland he was educated at Monmouth, in a convent of the Benedictines, whose society he entered. He was afterwards made archdeacon of Llandaff, whence he was, in 1152, raised to the bishopric of St. Asaph. The state of affairs in North Wales induced him to retire to the court of Henry II. He died in 1154. Geoffrey wrote various works; but his Chronicle or History of

the Britons is the only production of his pen which requires notice. This Chronicle is now known to be, as the compiler states, chiefly a translation from Armorican manuscripts discovered in Brittany by Walter Calenius, an archdeacon of Oxford. It contains a pretended genealogy of the kings of Britain from the time of the fabulous Brutus, or Brute, the Trojan, to the death of Cadwallader, king of Wessex, in 688. It was first printed by Ascenius, at Paris, in 1508. An English translation by Aaron Thompson, at London in 1718, was reprinted in Bohn's Antiquarian Library, 1848. We are indebted to Geoffrey for preserving, and perhaps reconstructing, the delightful legends of Arthur and his knights, the exquisite fiction of Sabrina introduced into Milton's Masque of Comus, the subject of Shakspeare's King Lear, and many of the finest episodes in Drayton's Polyolbion; while Tennyson is indirectly his debtor.

GEOFFRIN, Marie Thérèse Rodet, Madame, born in 1699, a woman alike distinguished by her qualities of mind and heart, who during half a century was the ornament of the most refined Parisian society. She became the wife of a man, of whom nothing can be said, excepting that he left her in the possession of a considerable fortune, which she employed partly in assisting the needy, partly in assembling around her a select circle of distinguished persons. Her benevolence was exerted in a touching and delicate manner. An attentive study of mankind, enlightened by reason and justice, had taught Madame Geoffrin that men are more weak and vain than wicked, that it is necessary to overlook the weakness and bear with the vanity of others, that they, in turn, may bear with ours. Her favourite maxim, therefore, was 'Give and forgive.' From her very childhood she was of the most charitable disposition. She wished to perpetuate her benevolence through the hands of her friends. 'They will be blessed,' said she, 'and they, in their turn, will bless my memory.' Thus she assigned to one of her friends, who was poor, an income of 1200 livres for his lifetime. 'If you should grow richer,' said she, 'distribute the money out of love to me, when I can use it no longer.' In her house the best society in Paris was assembled. Cultivated minds of every description found access to her. None could there claim a preference: the mistress of the house herself was far from desiring any precedence; she was only amiable and animating. She died in 1777. Three of her friends, Thomas, Morellet, and D'Alembert, dedicated particular writings to her memory, which, with her treatise, Sur la Conversation, have been republished.

GEOFFROY. The name of three French chemists.—1. Étienne François, surnamed the *Elder*, the son of an apothecary, was born at Paris, 13th February, 1672. He was brought up at home, where he had continual opportunity of meeting with Cassini, Homberg, and other eminent men, and where he acquired a knowledge of pharmacy and chemistry. He afterwards studied medicine at Montpellier and elsewhere, accompanied Marechal de Tallard, ambassador to London, where he was elected fellow of the Royal Society. He next went to Holland, returned to Paris, then to Italy, as physician of De Louvois, returned to Paris, graduated in 1706, and in 1707 he succeeded to the chair of chemistry in the Jardin du Roi, which had been previously held by Fagon, the royal physician, and delivered lectures which attracted numerous students. In 1709 he became professor at the Royal College, where he remained till his death. Geoffroy published papers upon many practical subjects, but his most important work was upon Chemical Affinity, in which he attempted to show by means of tables the relative attractions of different bodies for each other. He also wrote a famous exposure of the tricks of the persons who at that time called themselves alchemists, and often succeeded in obtaining money from the unwary, who expected in return to be initiated into the preparation of the philosopher's stone. Geoffroy died at Paris, January 6, 1731. A Treatise on Materia Medica, in three vols., was published after his death at Paris, 1741.—2. Claude Joseph, surnamed the *Younger*, a brother of the preceding, was born at Paris, August 8, 1685, devoted himself to pharmacy, and was a botanist before applying himself to chemistry. He accordingly devoted a good deal of attention to the chemistry of plants, and of their proximate principles, their colours, and essential oils, and had even discovered the decomposition of the latter into an acid and an inflammable oil. His separate researches, published in the memoirs of the Academy, of which, as well as his brother, he was a member, are very numerous, and are distinguished by their directness and precision.—3. N. . . , son of Geoffroy the younger, died at an early age, June 18, 1753. That same year he published his only work, on the analysis of bismuth, and the analogy of that metalloid to lead.

GEOFFROY, Julien Louis, a celebrated French critic, was born at Rennes in 1743. He studied in the schools of the Jesuits, and was left in very straitened circumstances by the suppression of that order. He then became a tutor in a private family. Having frequent opportunities of visiting the theatre, he contracted a taste for the drama, which led him to the study of the dramatic art, to an examination of its principles, the genius of the poets, and the talents of the actors. In order to understand more thoroughly the theory of the art he wrote a tragedy—the Death of Cato. He offered the piece to the directors of the theatre, who received it, and granted him free entrance. This was all he wished; and he never made any attempt to bring the piece on the stage. Geoffroy carried off the annual prize for the best Latin discourse in 1773 and the two succeeding years, and these successes procured for him the professorship of rhetoric at the College of Navarre, and some time after at the College Mazarin. In the competition for the prize offered by the French Academy for the best panegyric on Charles V. La Harpe was the successful candidate, but honourable mention was made of Geoffroy's performance. On the death of Fréron he was appointed editor of the Année Littéraire, and conducted that journal from 1776 till two years after the breaking out of the revolution. During these fifteen years he enriched it with profound and interesting articles on philosophy, morals, and literature. In 1800 he became dramatic critic for the Journal des Débats, which afterwards appeared under the name Journal de l'Empire. The Journal de l'Empire, during the time that Geoffroy wrote its *Feuilleton*, had the most extensive circulation of all the French daily papers. He published a translation of Theocritus in 1801, and a commentary on Racine in 1808. He died in Paris, February 26, 1814.

GEOFFROY ST. HILAIRE, Étienne, one of the most distinguished French naturalists, born at Étampes in 1772, was intended for the church, and made his first studies in the College of Navarre at Paris, where, by Brisson's suggestion, he united theology with natural science. At a later period, being admitted to the College of Lemoine, he studied crystallography under Haüy and Daubenton, who both gave him their friendship. When, in 1792, the former was imprisoned as a refractory priest, Geoffroy exerted himself so earnestly on his behalf that he was reclaimed by the Institute and regained his freedom on the very eve of the September massacres.

His exertions on this occasion having brought him under the notice of the literati of the capital, he soon became generally known. At the age of twenty-one he obtained, through the influence of Haüy, the chair of zoology in the Parisian Jardin des Plantes, which in 1793 was made the central establishment of natural science. In 1795, having been brought into correspondence with Cuvier, then an obscure family tutor in Normandy, Geoffroy invited the young man to Paris to assume, as he said prophetically, the place of a new Linnæus. As a member of the Egyptian expedition in 1798 he founded the Institute of Cairo. In his researches and collections he displayed equal industry and enthusiasm, and by his firmness secured his rich Egyptian collections for France, though the capitulation had ceded them to Great Britain. On his return he resumed his former situation in Paris, and was appointed in 1807 member of the Institute, and in 1809 professor of zoology to the medical faculty. In 1810 he was sent by the government to Portugal on a mission the object of which was to obtain from the collections of that kingdom all the specimens which were wanting in those of France. He took no part in politics, although he sat for his native town in the chamber of deputies in 1815. He devoted himself especially to zoology, comparative anatomy, and the philosophy of natural history. In regard to philosophical research he is nearly allied to the German school, and was hailed by Goethe as an apostle of the true synthetic doctrine. The fundamental idea brought conspicuously forward in all his works is, that in the organization of animals there is only one general plan, one original type, which is modified in particular points so as to present differences of genera. This view met with strong opposition from Cuvier, and a violent rupture took place between the friends in the sittings of the Academy of Sciences in July, 1830. It is pleasing to note that the friendship was renewed with all its former warmth in their later days. In his last years, although stricken with total blindness, Geoffroy devoted much of his time to the study of malformations and monstrous births. He died at Paris in 1844. His views in regard to the philosophy of natural history are developed in his work Sur le Principe de l'Unité de Composition organique (Paris, 1828). See also his Philosophie anatomique (two vols. 1822); Histoire naturelle des Mammifères, written in conjunction with Frédéric Cuvier (three vols. 1819–37); Notions de Philosophie naturelle (1838).

GEOFFROY ST. HILAIRE, ISIDORE, a physiologist and naturalist, son of the preceding, was born at Paris 16th December, 1805. Under the direction of his father he early devoted himself to natural philosophy, became assistant naturalist at the Museum when only nineteen years old, and in 1830 delivered zoological lectures in that institution as his father's substitute. Three years afterwards he was elected to the Academy of Sciences. He was then publishing a great work in which he enlarged upon a branch of the natural science outlined by his father; this was his Histoire générale et particulière des Anomalies de l'Organisation chez l'Homme et les Animaux, ou Traité de Tératologie (three vols. 8vo, with atlas of plates, 1832-37). On its completion he was appointed assistant lecturer to his father at the Faculty of Sciences, afterwards filled some important offices in the university, and in 1850 resigned the post of general inspector to resume the chair of zoology, to which he was then formally appointed. In 1852 he published the first volume of a magnificent work, Histoire générale des Règnes organiques, in which he intended to develop the doctrines handed down to him by his father, but which is left in an unfinished state by his premature death in 1861. He paid much attention to the domestication of foreign animals in France, as appears from his treatise Domestication et Naturalisation des Animaux utiles (1854), and has advocated the use of horse-flesh as food in his Lettres sur les Substances alimentaires (1856). He also published an excellent life of his father under the title Vie, Travaux, et Doctrine scientifique d'E. Geoffroy St. Hilaire (1848).

GEOGRAPHICAL SOCIETIES are associations formed with the view of obtaining and disseminating geographical knowledge. This is attained, in the first instance, by members undertaking distant travels, at their own expense in some cases, in others assisted by the funds of the society or grants from government; and, in the second instance, by lectures delivered and works issued under the auspices of the society, or by papers read and commented on at the periodical meetings. In point of seniority the first of these associations is the Société de Géographie of Paris, founded in 1821, to which we are indebted for the valuable Recueil de Voyages et de Memoires (seven vols. 1824–44), and their journal, the Bulletin de la Société de Géographie, commenced in 1822. The German Gesellschaft für Erdkunde held its first sittings in Berlin in 1828, under the presidency of Ritter, and has counted among its members many of the most famous of modern geographers. The more important results of its investigations are published yearly in the Zeitschrift der Gesellschaft für Erdkunde zu Berlin. By far the most important of those institutions, however, is the Royal Geographical Society, established in London in 1830. The principal travellers and geographers of Britain, or indeed of the world, are or have been connected with this society, and such names as those of Livingstone, Burton, Baker, Speke, Barth, Wallace, Cameron, Stanley, Thomson, Johnston, Bent, Curzon, Markham, Nansen, and many other well-known travellers, are to be found attached to papers in its Journal (1831–80, fifty vols.) and Proceedings (ceased in 1892), or in the Geographical Journal, which it has issued since 1893 in monthly parts, and which includes the society's Proceedings. It has a capital of nearly £50,000, and large sums are devoted annually to aid the cause of geographical research, or as awards and recognition of services rendered to the science. The Russian Geographical Society, founded at St. Petersburg in 1845, has greatly extended our knowledge of Central Asia and Asiatic Russia. Following the lead of other nations, Italy has her Società Geografica, founded at Florence in 1867, and issuing an annual Bollettino. The American Geographical Society was founded at New York in 1852, and publishes an interesting journal. The Royal Scottish Geographical Society was founded in 1884. It publishes an excellent monthly magazine, and its members number between 1500 and 1600. The Royal Geographical Society has a membership of between 3000 and 4000.

GEOGRAPHY (from the Greek *gē*, earth, and *graphō*, I write), the description of the earth, of the condition of our globe. The earth may be considered as a world, in relation to the other worlds; or as a body of different parts, properties, and phenomena, which, at the same time, is inhabited by beings of different natures; or as the residence of free moral agents, among whom its surface is divided, and through whose influence it undergoes many changes. Geography, therefore, is commonly divided into mathematical or astronomical, physical, and political. The two first, taken together, are also called *general geography*.

Mathematical or *Astronomical Geography* has for its object the determination of the form and dimensions of the earth, and its relations with the celestial

bodies; it treats of the earth's motion, and the laws by which that motion is governed, together with the phenomena of the movements of other cosmical bodies on which depend the succession of day and night, the seasons, and the eclipses and occultations of the sun, moon, and planets; of the mode of determining the position of places on the earth's surface, and of representing any portion of that surface on maps or charts; of the construction of globes and other instruments necessary for the solution of astronomical problems, and the modes of solving such problems. Most of these topics belong as much to astronomy as to geography. See ASTRONOMY, EQUATOR, LATITUDE, LONGITUDE, &c.

Physical Geography describes the principal features of the earth's surface, as consisting of land and water; the extent and configuration of the continents and islands; the elevation and direction of the mountain chains; the conformation of the plains and valleys, their altitude above the sea-level; the soil, climate, and animal and vegetable productions of the different countries. It embraces also the various phenomena of the ocean: the inequalities of its depth, saltness and temperature, the direction and velocity of currents, the tides; of inland waters, as rivers, lakes, &c. It also comprehends many of the topics usually treated under meteorology and climate: the mean temperature of different countries; the height of the snow-line; the prevailing winds; the quantity of annual rain, of evaporation, &c.; and the effect of all these circumstances on the animal and vegetable world, and on the human race.

Political Geography embraces, in the first instance, the description of the political or arbitrary divisions and limits of empires, kingdoms, and states; and in the second, that of the laws, modes of government, and social organization which prevail in the different countries. The details of this branch of the subject will be found under the names of the various countries, cities, and towns.

The earliest idea of the earth formed by mankind seems to have been that it was an immense disk, in the centre of which their own land was situated, surrounded by the ocean, and covered by the sky as with a canopy. The Phœnicians were the first people who made any great progress in extending the bounds of geographical knowledge. They seem to have explored all the shores of the Mediterranean, and at an early period to have passed the Pillars of Hercules (the Strait of Gibraltar), and visited to some extent the Atlantic shores of Europe and Africa, extending their voyages as far north as Britain, and as far south as the Tropic of Capricorn. What knowledge the Hebrews had of distant lands was probably acquired from the Phœnicians. In the Bible the remotest places mentioned are, to the north, Gomer (Gen. x.), probably the Kimmerii of Herodotus, and Kir, the Caucasian region of the Kur; to the east, India (Esther i.); to the south, Cush (Ethiopia), Ludim or Lubim (Lybia), Sheba, and Ophir, probably a place in South Asia; to the west, Tarshish, supposed by some to have been Tartessus in Spain, by others Carthage. So rapid was the advance of geographical knowledge between the date of the Homeric poems (which may be regarded as representative of the ideas entertained about the commencement of the ninth century B.C.) and the time of Hesiod (800 B.C.), that while in the former the earth is supposed to resemble a circular shield surrounded by a belt of water which was the source of all other streams, and the names of Asia and Europe applied only, the former to the upper valley of the Cayster in Asia Minor, and the latter to Greece north of Peloponnesus, Hesiod mentions parts of Italy, Gaul, and Spain, and is acquainted with the Scythians and with the Ethiopians of South Africa. The first attempt to enlarge the circle of geographical information by an exploring expedition was made by Neku or Necho II., king of Egypt, about 604 B.C. He sent down the Red Sea a fleet manned by Phœnicians, which, in the third year, after having circumnavigated Africa, returned to Egypt by the Pillars of Hercules. On their return the explorers asserted that during a part of the voyage, when sailing from east to west, they had the sun on their right hand, that is, in the north. This statement, which shows that they must have sailed to the south of the equator, Herodotus, who relates this extraordinary voyage, naturally discredited, but to modern science it is the best proof that the voyage actually took place. The seventh and sixth centuries B.C. were memorable for the great advance made in regard to the knowledge of the form and extent of the earth. Thales and his pupil Anaximander, reputed to have been the first to draw maps, exploded many errors, and paved the way, by their observations, for the attainment of a sounder knowledge. Of the maritime expeditions of the Carthaginians there is but one we have any authentic account of—that of Hanno, which took place about 580–570 B.C. With a fleet of sixty vessels he passed the Strait of Gibraltar, and sailed down the coast of Africa as far as the Gulf of Benin, or, according to others, no farther than the river Nun. The history of Herodotus (born 484 B.C.) gives us a complete representation of all that was known of the earth's surface in his age. The world was believed to be bounded to the south by the Red Sea or Indian Ocean, and to the west by the Atlantic, while its eastern boundaries were conjectured to be nearly identical with the limits of the Persian Empire, and its northern termination somewhere in the region of the amber lands of the Baltic, which had been visited by Phœnician mariners, and with which the people of Massilia (Marseilles) kept up constant intercourse by way of Gaul and Germany. The Indian expedition of Alexander the Great (330 B.C.) greatly enlarged the ancient knowledge of Northern and Eastern Asia. He penetrated to the Hyphasis, the modern Sutlej, the most eastern and most important of the five rivers which flow through the Punjab. The ambassadors of Seleucus, one of his successors, visited the city of Palimbothra, which was probably on the site of the modern Allahabad. Beyond this the Greeks seem to have known little or nothing of Eastern Asia. About 320 B.C. Pytheas, a seaman of Massilia, sailed along the western coasts of Spain and Gaul, visited Britain, and, pursuing his voyage, discovered an island, henceforward famous as *Ultima Thule*, which is supposed to have been Iceland. An important advance in the science was made by Eratosthenes (276–196 B.C.), who first used parallels of latitude and longitude, and constructed maps on mathematical principles. He considered the world to be a sphere revolving with its surrounding atmosphere on one and the same axis, and having one centre. He believed that only about one-eighth part of the earth's surface was inhabited, while the extreme points of his habitable world were Thule in the north, China in the east, the Cinnamon coast of Africa in the south, and Cape St. Vincent in the west. The Geography of Strabo, written about the beginning of the Christian era, embodies all that was known of the science at that period. The countries lying round the Mediterranean were known with tolerable accuracy, but the Atlantic shores of Europe were very vaguely comprehended, while of the northern and eastern portions the most erroneous notions prevailed. Nothing whatever was known of Scandinavia, Russia, or Northern Germany, nor of Siberia, Tartary, China, Japan, or the great Asiatic

Archipelago. The Caspian was thought the limit of the earth to the north, and to be connected with the Eastern Ocean by a sea occupying the space now known to be covered by Siberia and Tartary. Of Africa only the northern part was known, south of which was supposed to be an uninhabitable torrid region. The next famous geographer we come upon is Ptolemy, who lived at Alexandria about the middle of the second century A.D. At this period the Roman Empire had reached its greatest extent, and all its provinces had been surveyed and were well known. Large advances had been made in the knowledge of the countries lying beyond the empire. The idea of a circumambient ocean had been abandoned, and an indefinite expanse of *terra incognita* substituted. Africa was represented as stretching indefinitely south, and was even carried round to join the east of Asia; so that the Indian Ocean was inclosed like the Mediterranean. In Europe, Spain and Gaul were now correctly delineated, together with the southern shores of Britain. The outline of Scotland and the relative position of Ireland are very incorrectly given. Thule is laid down as an island about 100 miles long, and from its position it is probable some part of Norway was meant. Northern Germany and the southern shores of the Baltic were pretty well known, as also some portion of Russia in the neighbourhood of that sea, and the southern part of European Russia. In Asia it was considered certain that there were wide regions inhabited by nomad tribes called Scythians, while from the far east came some vague reports of China. From the time of Ptolemy up till the thirteenth century no advance was made in geographical knowledge, and his statements were everywhere unquestioned until the records of Marco Polo opened up new fields of inquiry. The account of his travels first made known to Europe the existence of Japan and of many of the East Indian islands and countries. But Marco Polo had unfortunately made no astronomical calculations, nor had he mentioned the length of the longest day at any given place; hence the celebrated school of Nurnberg geographers, having no certain data for estimating the extent of countries which he had traversed, incorporated on their globes and maps their own rough estimates of the length of his days' journeys; and, taking Ptolemy as their basis, they represented Asia as extending across the Pacific, and having its eastern shores somewhere in the region of the Antilles. These calculations misled Columbus to suppose that by sailing 120° west he would reach the wealthy trading marts of China, and the result of this conviction was the discovery of the New World (1492). From this time forward the progress of discovery was extremely rapid. In 1497 the Cape of Good Hope was doubled by Vasco da Gama, four years after its discovery by Bartholomew Dias. Within thirty years from the date of the first voyage of Columbus the whole of the east coast of America, from Greenland to Cape Horn, had been explored, and Spanish keels were ploughing the Pacific. In 1520 Magellan passed the straits which bear his name, and his vessel, crossing the Pacific and Indian Oceans, returned to Europe by way of the Cape of Good Hope, being the first that had circumnavigated the globe. The west coast of America was explored as far as the Bay of San Francisco about the middle of the sixteenth century, and considerable progress was made by the Spaniards in acquiring a knowledge of the interior of South America. At the same time discovery in the east advanced with rapid strides. Within twenty years of Gama's arrival in India the coasts of East Africa, Arabia, Persia, and Hindustan had been explored, and many of the islands of the great Archipelago discovered. The desire to reach India by a shorter route than those by the Cape of Good Hope or Cape Horn led to many attempts to find a north-west passage, which, though they failed in their object, materially enlarged our knowledge of the Arctic regions. The expeditions of Willoughby and Frobisher in 1553 and 1576, of Davis in 1585, of Hudson in 1607, and of Baffin in 1616, were the most important in their results towards this end. By the middle of the seventeenth century the Dutch, under Tasman and Van Diemen, made the Australasian Islands known to the world. Late in the following century Captain Cook made strenuous efforts to discover the southern continent, which was thought necessary to balance the northern one, and though unsuccessful in his aim, added largely to geographical knowledge by his survey of the Pacific and its innumerable islands. The Antarctic Continent was at last discovered in 1840 by American, English, and French expeditions, under their respective commanders Wilkes, Ross, and Dumont D'Urville; and to crown the list of oceanic discoveries, the north-west passage was found by M'Clure in 1850. Hearne, Mackenzie, Back, Franklin, Richardson, Lewis, Clarke, and Frémont deserve mention as explorers of North America; Humboldt, Spix and Martius, von Tchudi, Schomburgk, among those of the South American continent. In Asia numerous travellers and geographers have contributed much to render our knowledge certain and precise in respect to most parts of the continent. The interior of Australia was in some measure explored by Sturt, Eyre, and Leichhardt; in 1860 the island was crossed for the first time from Melbourne to Carpentaria by Burke, Wills, and King, and in 1861–62 by M'Douall Stuart from Adelaide to the Indian Ocean; while many exploring journeys have since been made. In Africa a host of travellers have struggled, in defiance of a deleterious climate, and often hostile natives, for more than a century past to penetrate the mystery which long enveloped that great division of the globe. Foremost among these we may name Bruce, Park, Denham, Clapperton, Barth, Burton, Speke, Grant, Baker, Livingstone, Rohlfs, Schweinfurth, Cameron, Thomson, Stanley, &c. The progress which has marked recent discovery has been materially assisted by the encouragement given by the governments of various countries, and by the efforts of the numerous geographical societies, missionary societies, trading associations, &c. Among famous modern works on geography are the Précis de la Géographie Universelle, by Malte-Brun; Ritter's Erdkunde im Verhaltnisse zur Natur und Geschichte des Menschen, and many valuable works by the same author and his followers—Berghaus, Stein, Wappäus, von Klöden, &c.; the extensive and recent Nouvelle Géographie Universelle of Élisée Reclus, with English translation, and the Dictionnaire de Géographie Universelle of Saint-Martin. Among English authorities may be mentioned Macculloch's Geographical Dictionary, Blackie's Imperial Gazetteer, and especially Stanford's Compendium of Geography and Travel (new edn., 12 vols., 1893 onwards). (See GAZETTEER.)

GEOLOGY (from *gē*, the earth, and *logos*, a discourse) is the science which investigates the history of the earth, or the successive changes which have taken place in the organic and inorganic kingdoms of nature, together with the causes of these changes, as far as they can be traced by observations on the structure and mode of occurrence of the mineral and organic substances that form, or are found in and upon, the crust of the earth.

To place the events of this complicated history in clear chronological succession is the chief business of the geologist; and in doing so he unites the present with past geological epochs, and discovers that the

physical world, as it now exists, is the result of all the past changes that have taken place in it. If, therefore, our knowledge were sufficient to admit of the construction of a complete system of physical geography, it would be but a full description of a geological epoch, namely, that of to-day; and a complete account of any old geological epoch would be a perfect description of the physical geography of the world at that time.

During the changes that are taking place in the earth, rocks, aqueous and igneous, are now being formed. First, we shall briefly discuss these processes; then apply the subject to rocks; and, lastly, give a concise account of the geological formations in ascending order.

The air and water, but especially the latter, act both chemically and mechanically on the crust of the earth. Many minerals in rocks, such as felspars, hornblendic minerals, mica, &c., are composed of silicates of alumina and soda, potash, lime, and magnesia. These are often associated with free silica. This is especially the case with some igneous rocks; and most of the stratified rocks consist in great part of substances of the same nature variously intermixed. Others consist of carbonate and sulphate of lime, &c., more or less pure. Of these, the carbonate of lime rocks, or common limestones, by far predominate; and they are sometimes nearly pure, forming immense areas of country, and sometimes mechanically intermingling, in every percentage, with other substances. All rain absorbs part of the carbonic acid in the air as it falls; and the water percolating through the rocks unites with and carries away in solution portions of the soda, potash, lime, or magnesia that enter into the composition of the minerals in rocks, and this promotes their disintegration. They crumble, and are in a condition to be borne to lower levels, and finally to the sea, by the mechanical agency of running water. Great quantities of lime and other salts are thus also carried in solution by the agency of brooks and rivers to the sea.

Frost is also a powerful disintegrator. Water percolates into hollows, joints, and cracks; it freezes and expands, and thus helps to rend and break up the rocky and earthy masses. Some of its most obviously powerful effects are seen in the regions of glaciers and drift-ice. In warm latitudes, glaciers are found only at those great elevations on mountain ranges that rise above the limits of perpetual snow. On the Himalayas, the loftiest peaks of which are about 29,000 feet high, the greater glaciers descend to the level of about 14,000 feet; in the Alps, in the lower glacier of Grindelwald, to 3300; and in the Glacier du Bois to 3350 feet above the sea. In the north of Norway, the southern part of South America, the Antarctic continent of Victoria Land, and in Greenland, the larger glaciers descend to the sea-level. In the two last-named regions, towards the poles, surfaces of vast extent are covered by a continuous mass of thick ice known as an *ice-sheet*. A glacier in temperate regions is supplied by the *drainage* of the snow that falls on those parts of the mountains that rise above the limits of perpetual snow; and its size is commensurate to the height of the mountains and the extent of area drained. Pressure of the yearly accumulating snow, and in less degree the summer's heat and the winter's cold, or, indeed, the summer day's thaw and the nightly frost, gradually change snow into ice, which, as experience proves, by constant fracture and regelation of parts, acts, as a whole, like a plastic body, and glaciers progress down valleys at slow rates, proportionate to the steepness of their inclination, the volume of ice, and the season of the year—moving faster in summer and autumn, and slower in winter. The effect of this motion in these icy masses is to grind, polish, scratch, and groove the rocky valleys over which the glaciers pass, removing asperities, and giving portions of the rocky floor rounded and mammillated forms, termed *roches moutonnées*. Ice-filled valleys are thus deepened and widened, and much sediment is formed and brought within reach of the transporting power of rivers. Large heaps of earth, stones, and masses of rock, called *moraines*, are also accumulated by glaciers, and are among their most important phenomena. See GLACIER.

In cold climates, where special glaciers descend to the sea, bergs break off, often laden with blocks and finer sediments, and, floating into milder regions, they deposit their freights where they chance to melt. The breaking up of the ice-foot on sea-coasts, and of river ice, also transports large quantities of matter, and scatters it abroad. The quantity of material *degraded* and spread in the sea by these united means is immense, and consists of mud, sand, gravel, and rounded, subangular, and angular blocks, often polished, grooved, and scratched; and from the irregular mode of its accumulation, and the frequent grounding and scraping of icebergs along the sea bottom, the whole of this matter, if exposed, would present one of the rudest forms of stratification.

Every long-continued rain exercises a powerful mechanical effect on the surface of the earth, carrying much sediment into water-courses, which unite to form brooks, rivulets, and finally, if the country be large, great rivers. Soft surface soil is thus easily carried away even in low countries, and in hilly and mountain regions great valleys and ravines are formed by running water and the long-continued attrition of stones driven onward by torrents over rocky surfaces. Great thunder-storms, water-spouts, and sudden thaws in snow-covered lands frequently produce startling effects, stripping large areas bare of soil, and hurrying to lower levels vast masses of earth, shingle, and boulders. As the accumulated waters in rivers reach low lands, their power of transporting coarse sediment decreases, and finally, in great rivers, like the Rhine, the Nile, the Ganges, and the Mississippi, only fine sediment is carried in suspension long before they reach the sea. The Mississippi affords a striking example of the quantity of sediment thus carried seaward. Given the breadth, depth, and rapidity of the river by a number of observations, the annual volume of water that flows past a point was obtained. Then by many hundred measurements the average quantity of sediment in suspension in the water was ascertained, and it was found that about 28,188,053,892 cubic feet of fine sediment is annually carried seaward. Some of this during floods falls on and helps to raise the modern delta, while a part is deposited on the plain between the bluffs higher up the river, which are themselves formed of the matter of a more ancient delta. Measuring the length and breadth, and estimating the depth of the modern delta, according to the present rate of sedimentary supply it must have taken not less, and indeed far more, than 14,204 years to form it, for a large quantity of the finer sediment goes out to sea. Taken together, the continents are drained by about twenty-six first-class rivers, besides a great number of smaller ones, each laden with sediment being hurried to lakes and to the sea.

Besides this, the quantity of salts that springs and streams hold in solution is immense. As an extreme case, take the Bath Old Well, which yields 126 gallons of water per minute, and holding 144

grains of salts per gallon in solution, we obtain 3732 lbs. per day, or 608 tons per annum of matter, dissolved out of the rocks by the water of this spring. As an ordinary case, take also the Thames, which flows through calcareous and clay areas, formed of the Oolites, Chalk, and Eocene strata. Given the average breadth, depth, and rapidity of the current at Teddington, and the quantity of salts (chiefly bicarbonate of lime) in solution, it is found that in this small river alone 377,058 tons pass annually out to sea. Taking all the streams and rivers of the world, the quantity of matter thus dissolved and carried away *invisibly* is immense.

The sea acting on its shores is also a powerful destroyer and modifier of the form of land. On the east and south of England, where the strata chiefly consist of boulder-clay, Tertiary clays, Chalk, and Oolitic sands, clays, and limestones, the waste of the softer strata is in many places calculated at about 2 yards a year. Where the strata are harder, as on the west coast, the waste is so slow as to be generally ignored by ordinary observers. But the form of the coast proves it. Hard rocks usually form promontories; and softer rocks, that have been worn back by the sea, lie in the hollows of bays. Many beaches are also strewed with pebbles derived from the waste of cliffs, and these, rattling on the beach with every breaker, not only themselves become worn, rounded, and polished, but they also assist in the work of destruction, which is often aided by landslips.

The mechanical sediments thus carried to sea, or into lakes and estuaries, are spread abroad by movements in the water, and form stratified deposits. In the sea such movements are of three kinds—1st, the stirring up and dispersion of sediment by the waves, principally during heavy gales. By this action a sifting process is exerted which leaves the larger matter near shore, the smaller substances travelling farther to sea. 2nd, Tidal movements; and 3rd, the great ocean currents. The lime and other salts in solution, carried by rivers to the sea, help to nourish plants, and shell-fish and other marine animals that inhabit the sea derive the material wherewith to form their skeletons from the salts of lime carried by rivers in solution to the sea; and by the life and death of these, vast masses of strata are in the course of time formed over large areas.

With sufficient time all land would, by these processes, be eventually degraded beneath the sea (as was supposed by the naturalist Ray), were it not that the loss is compensated by disturbance and elevation of land always slowly taking place over portions of the continents and islands of the world. Large areas are also slowly depressed beneath the sea; but to maintain the average balance of sea and continent, the amount of land elevated must exceed that depressed, or be equal to the amount of that depressed by gradual submergence, added to that destroyed by degradation.

The evidences of past *elevation and depression* are simple. *Elevation.*—1st, A large proportion of the rocks in many mountain ranges, however high above the sea, contain marine fossils, generally altogether, or nearly altogether, of extinct species. Such strata are in great part highly disturbed and largely *denuded*. 2nd, On all continents and on many large islands raised beaches occur, and also superficial accumulations of loose strata, lying on the older rocks, and yielding fossil shells, in great part, or altogether, identical with those that now inhabit neighbouring seas; and these organic remains occur in such a manner, that it is plain they lived and died on the spots where they now lie ere those parts of the sea-bottom were elevated. In Britain, such beds are found from 25 to 120 feet above the sea; and on the west of South America, 1300 feet on the western side of the Andes. 3rd, Experience shows that certain volcanic regions subject to earthquakes are areas of elevation. The earthquake of 1835 in Chili is an instance when a long tract of the coast of South America was suddenly raised from 4 to 12 feet, and part of the sea-bottom converted into land. The chain of the Andes is *volcanic*, and the elevating forces and earthquakes of South-western America are connected with this circumstance. The Mediterranean volcanic region (though marked by many oscillatory movements) is also, as a whole, one of elevation. The same is true of the volcanic islands of the Pacific, and also of Java, which contains many active volcanoes, and around the shores of which there are old coral reefs 140 feet above the level of the sea. Many coral reefs, according to Darwin, whose views, however, are still *sub judice*, yield evidence of *depression* of land, as explained in article CORAL.

During such depressions strata may accumulate to an immense thickness under favourable conditions of supply, and time being also allowed for consolidation, when these are again upheaved they will, both as regards quantity and structure, be more apt to resist destruction than smaller masses of (probably) softer strata that were formed during periods of minor oscillations of sea and land.

Strata are consolidated (petrified) chiefly by pressure and chemical decomposition and recomposition. Some formations are many thousands of feet in thickness. In a set of strata 10,000 feet thick, the superincumbent weight on the lowest bed would be about 12,333 lbs. per square inch; but besides this, more intense pressures have taken place throughout all but the very latest geological epochs. This kind of pressure has been brought about by crumpling of the crust of the earth by means which are still far from being properly understood, the result being that over broad areas rocky masses have been contorted and compressed to a great degree, and mountain ranges upheaved. In some rocks the particles are partly cemented by oxides of iron, in others by carbonate of lime. Beds of limestone are often formed from calcareous springs. Marine strata formed of limestone, in the Adriatic, were found by Marsilli to be consolidated a foot beneath the surface. A great many rocks contain more or less carbonate of lime, and along with this, or alone, many others contain silicates of soda or potash. These are soluble in carbonic acid, and, entering into new combinations, the whole becomes petrified. During these processes marine organisms are imbedded and cased in stone, and in a less degree terrestrial plants and animals are floated into lakes and estuaries, and occasionally out to sea, where those parts that escape decay and predaceous fish may become fossilized.

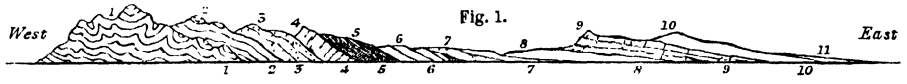
Igneous rocks also form a considerable portion of the visible crust of the earth, though much smaller in amount than those of sedimentary origin. At present there are more than 150 known active volcanoes in the world, and many others probably not long extinct, which may again break out. Some volcanoes are submarine. Most of them occasionally vomit lavas and ashes. The ashes often fall into the sea (sometimes travelling in the air hundreds of miles), and form peculiar stratified deposits. Modern lavas are chiefly felspathic (trachytic), augitic (basaltic), and of the nature of obsidians. They are amorphous, crystalline, porphyritic, glassy, compact, scoriaceous, vesicular, amygdaloidal, &c. Crystalline lavas are mostly formed during slow cooling, the substances composing the mass crystallizing accord-

ing to their chemical affinities. Porphyritic lavas contain distinct crystals of some substance (such as felspar or augite) formed while cooling, and imbedded in the mass. Vesicular lavas are the result of the mixture of steam with, and the formation of gases in, the plastic mass; and an amygdaloid is formed by these vesicles becoming filled (by infiltration) with foreign substances, such as zeolitic minerals, carbonate of lime, &c. Lavas are sometimes columnar. When a large stream of melted lava flows over some kinds of strata, it generally alters them at the points of contact, and this being the case at the surface, the same effect in stronger degree must often be produced at greater depths in the body of the earth, where the matter remains for a longer time in a melted condition. The most plausible modern theory regarding the earth's interior is that of the Rev. O. Fisher, which postulates a thin crust resting upon a denser molten substratum in which gases are dissolved at high pressure. This theory harmonizes with many facts regarding volcanoes, terrestrial magnetism, and movements of the earth's crust. Observations in gravity and underground temperature also support it. No one hypothesis is perfectly satisfactory in all its details, but this at least seems certain, that the heaving force which raises, and finally forcibly ejects, the lava is high-pressure steam. For when a great eruption takes place, volcanic ashes, fine and coarse, are shot in a great column, sometimes 5000 feet high, into the air. It spreads out at the top like a pine-tree, lightnings play about its edges, and copious showers of rain fall from the condensation of the steam.

It now remains to be proved that the rocks which form the crust of the earth had the same general origin with the igneous rocks and sedimentary strata now forming. Stratified rocks are known to be of sedimentary origin:—1st, From their structure. They are arranged in layers and beds in a manner identical with that in which sediments are arranged when distributed by water. 2nd, The material of these beds is generally composed of more or less consolidated mud, sand, pebbles, and organic remains comparatively pure or variously intermingled. The sand and pebbles are in almost all cases rounded, like the sand of the sea and the pebbles of a beach or sea-bottom of the present day; and the fossils which are found imbedded in the variously-constituted strata, or which in some cases entirely compose them, are known to be chiefly marine, and sometimes such as live in fresh water; partly because some of them are identical with living species; and chiefly, because by far the greater proportion, though extinct, are a few of them associated with the *fossil* remains of living species, and the rest belong to well-known *genera*, or else are associated with them.

The *superposition of strata* and *the succession of life in time* prove the rocks to be of different ages. Observation and experiment alike establish the doctrine of superposition. Thus, at the edges of the strata on which London stands, the Woolwich and Reading beds are *seen* to lie on the chalk. Far within these edges, well-sinkers are well aware that often after sinking several hundred feet through the London clay, the chalk is reached. In like manner, proceeding westward across the middle of England, it is found that the outcrop of the chalk rests on the Greensands, the Greensands on the Upper Oolites, the Lower Oolites on the Lias, the Lias on the New Red marl, and so on through lower members of the geological series, thus—

Fig. 1.



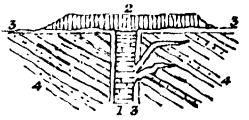
Succession and General Arrangement of Strata in Wales and Part of England.

11, London clay, &c.; 10, Chalk, &c.; 9, Oolitic rocks; 8, Lias; 7, New Red marl and sandstone; 6, Permian; 5, Coal-measures, and 4, Carboniferous Limestone; 3, Old Red Sandstone; 2, Silurian rocks; 1, Ordovician and Cambrian rocks. The structure of the greater part of England thus becomes exceedingly simple, consisting of a cluster of Palæozoic mountains on the west (Wales, &c.); and plains, and two high table-lands on the east, formed by the escarpments of the Oolites and Chalk. Each great group consists of several subdivisions called formations, and each group, and even to a considerable extent each minor subdivision, is characterized by the presence of distinct assemblages of organic remains. This, which constitutes the *succession of life in time*, was the great discovery of Wm. Smith. The complete series (irrespective of minor and continental details) is as on p. 139.

Igneous rocks are associated in different localities with the formations named in the foregoing table. For instance, there are no volcanic rocks in Wales associated with the Carboniferous strata, while there are in Scotland; and so of other formations. Some of the igneous rocks consist of beds of volcanic ashes, others of old lavas, others of masses of matter which were intruded among the strata from below. Rocks that have been melted are known to be igneous by their crystalline, slaggy, scoriaceous, vesicular, or columnar structures, and also by the effects they have produced on the strata with which they are associated. Shales, sandstones, &c., are often hardened, bleached, and even vitrified at the points of junction with greenstone, basaltic, and felspathic dykes, or old lava beds (fig. 2), and the same kind of alteration takes place on a greater scale when large masses of igneous rocks have been intruded on the strata.

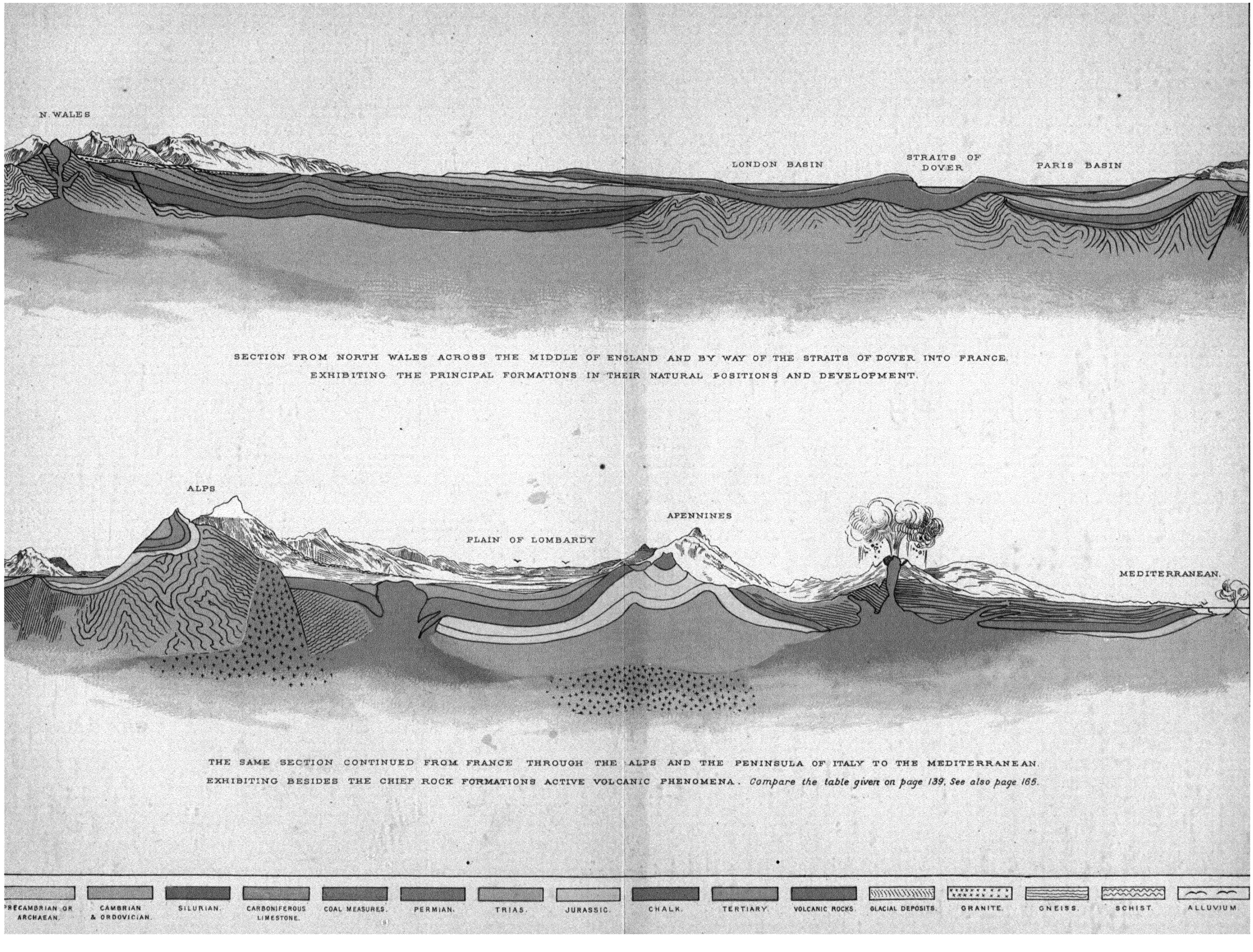
Changes of a more general character are especially marked in cases where granite, syenite, and their allies are associated with stratified deposits. Their igneous affinities are known by their crystalline structure, their modes of occurrence, and the effects they produce on the strata. Granite is composed of crystals of quartz, felspar, and mica; and syenite, of orthoclase felspar and hornblende. They often send veins or dykes into stratified rocks with which they are in contact, and frequently all along the line of junction, and often at great distances from it, alterations of the strata of an extreme character (metamorphism) are common. One marked distinction between granitic and volcanic rocks is, that the former have never risen to the surface in a melted state, and overflowed like lava streams. This and their frequently largely crystalline structure, together with peculiarities of crystallization showing the presence of moisture, and also the transformations effected on the adjoining strata,

Fig. 2.



1. Dyke with veins.
2. Overflow of lava.
3. Altered strata at junction.
4. Unaltered sandstone and shale.

A SECTION OF THE EARTH'S CRUST ACROSS ENGLAND, FRANCE, AND ITALY.



SECTION FROM NORTH WALES ACROSS THE MIDDLE OF ENGLAND AND BY WAY OF THE STRAITS OF DOVER INTO FRANCE, EXHIBITING THE PRINCIPAL FORMATIONS IN THEIR NATURAL POSITIONS AND DEVELOPMENT.

THE SAME SECTION CONTINUED FROM FRANCE THROUGH THE ALPS AND THE PENINSULA OF ITALY TO THE MEDITERRANEAN, EXHIBITING BESIDES THE CHIEF ROCK FORMATIONS ACTIVE VOLCANIC PHENOMENA. *Compare the table given on page 139. See also page 165.*

Periods.	Epochs.	Groups.	Formations.
Tertiary or Cainozoic.	Recent		Alluvia, and estuarine beds, &c., now forming.
	Pleistocene		River alluvia, &c., with flint implements, bones of Mammoth and other mammalia, shells, &c.; bone caves, &c., partly connected with Glacial epoch. Raised-beaches. Great glacier moraines, Eskars or Kaimes and Boulder-clay, &c. Forest bed, &c.
	Pliocene		Norwich Crag and Chillesford Clay. Red Crag. Coralline Crag.
	Miocene		Absent in Britain.
	Oligocene		Hamstead beds. Bembridge beds. Osborne beds. Headon beds.
	Eocene		Upper Bagshot sand. Middle Bagshot: Barton clay; Bracklesham beds. Lower Bagshot sands and clays. London clay. Woolwich and Reading beds. Thanet sands.
Secondary or Mesozoic.	Cretaceous	Upper Cretaceous	Maestricht and Faxoe beds, absent in England. Chalk Upper greensand. Gault.
		Lower Cretaceous	Lower greensand, Atherfield clay, &c. (Neocomian).
		Wealden series	Weald clay and Hastings sands, Lower Neocomian.
	Jurassic	Upper Oolite	Purbeck beds. Portland Oolite and sand. Kimmeridge clay.
		Middle Oolite	Calcareous grit and Coral crag. Oxford clay and Kellaways rock.
		Lower Oolite — Great Oolite	Cornbrash Forest Marble and Bradford clay. Great or Bath Oolite and Stonesfield slate.
		Lower Oolite — Inferior Oolite	Fuller's-earth and Fuller's-earth rock. Inferior Oolite and sand.
		Lias	Upper Lias. Marlstone or Middle Lias. Lower Lias clay and limestone.
	Trias		Rhætic beds. New Red marl and sandstone (Keuper). *Muschelkalk*, absent in Britain. New Red Sandstone (Bunter).
Palæozoic.	Deutozoic	Permian	Magnesian limestone. Sandstone, red marl, conglomerate, and breccia (Rothliegende)
		Carboniferous	Coal-measures and Millstone grit. Carboniferous limestone and shale, with coal in places. Lower Limestone shale.
		Devonian	Devonian and Old Red Sandstone.
	Protozoic	Silurian	Ludlow series. Aymestry limestone. Lower Ludlow rocks. Wenlock limestone. Wenlock shale and Denbighshire flags. Woolhope limestone. Tarannon shale Llandovery rocks.
		Ordovician	Bala or Caradoc beds. Llandeilo beds. Arenig beds.
		Cambrian	Tremadoc series. Lingula flags. Menevian beds. Harlech beds.
Archæan.	Eozoic		Variously-named Pre-Cambrian formations.

prove the granitic rocks to have cooled and consolidated deep beneath the surface. The metamorphic rocks with which they are associated are usually of the nature of gneiss, mica slate, chlorite slate, talc slate, quartz rock, crystalline limestone, &c. In Scotland, Ireland, Norway, Canada, &c., limestones, calcareous sandstones, and sandstones, as they approach granites, lose their (sometimes fossiliferous) characters, and become changed into crystalline limestones, serpentine, &c., and quartz rock. In

other cases gradual changes of a different kind are observed in slaty and schistose rocks as they approach granites. Clay slates are simply clays consolidated by pressure, often affected by cleavage, and sometimes chemically altered. Approaching

Fig. 3.



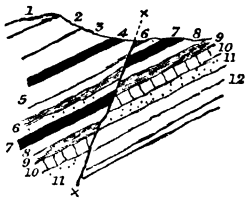
1. Granitic mass with injected veins among gneissic rocks.
2. Gneiss, metamorphosed strata.

granites, ordinary slates often assume a foliated structure by the development of distinct mineral layers of quartz, felspar, and mica. This is gneiss. Analyse some kinds of mica slate, gneiss slate, and common sandy clay, and their average composition will not differ more than three clays, three pieces of gneiss, and three bits of granite often do from each other. When slate is changed to gneiss, there is no development of materials which were previously absent, but simply a re-arrangement of its constituents, according to their chemical affinities, in rudely crystalline layers, which seem in gneiss to have found facilities for their development in pre-existing planes, whether of bedding or cleavage; or, in other words, if the rocks be uncleaved when metamorphism occurs, the foliated planes show a tendency to coincide with those of bedding; but if intense cleavage has preceded, the foliation will generally tend to follow the planes of cleavage. The most important agent producing metamorphism on a large scale has been the enormous lateral pressure caused by the wrinkling of the crust, aided by intense heat and the presence of highly-compressed water-vapour. The net result has been to crumple, crush, and roll out rocks of all kinds, with production of new divisional planes and formation of various minerals. The term *dynamical metamorphism* is applied to these changes, which are primarily of a mechanical nature. The intensity in many countries of these metamorphisms, extending over many thousands of square miles (as in Scotland, Norway and Sweden, and Canada), and for thousands of feet in thickness, proves that it was the result of a long-continued process, and probably in all cases at considerable depths, when the strata, changed into gneiss and its allies, were buried beneath other thick masses. The whole has then been upheaved, disturbed, and faulted (often many times), and, *after denudation* (washing away of the soil by water), the gneissic and the more thoroughly metamorphosed and sometimes intrusive granitic rocks were at length exposed at the surface.

The older rocks have been frequently deeply depressed beneath the surface, and exposed to altering influences, and therefore larger and more numerous portions of them have generally been metamorphosed than of rocks of later date. This circumstance helped to deceive the older geologists, who believed all the gneissic rocks to be primitive. They are now known to exist of all ages. In Norway, for instance, gneiss lies below unaltered Ordovician rocks; and again, some of the Protozoic rocks themselves are changed into gneiss in other localities of the same country. The Highlands of Scotland present identical phenomena. In Devonshire, Devonian and Carboniferous rocks have been converted into gneiss in the neighbourhood of the granite of Dartmoor; and in the Alps and Andes there are gneissic rocks, some of them of very old date, and others of the ages of the Lias, Oolites, Chalk, and even of the Eocene strata.

In the following description the formations, groups, epochs, and periods are treated in ascending order, and a few characteristic fossils or extinct plants and animals of the respective strata are represented in the accompanying plates. The descriptions refer chiefly to British strata. In the small area of Great Britain a more complete series exists than in any other part of the earth's surface of equal dimensions. The greater part of the European series is, indeed, nearly complete in England and Wales alone; and since the days of William Smith, the British rocks have generally been the types to which formations in other parts of the world have been referred. All the British rocks are more or less faulted; but the contortions (fig. 1) and faults (fig. 4) are greater and more numerous in the older formations. A fault is a dislocation, accompanied by a downthrow of the strata on one side.

Fig. 4.[1]



ARCHÆAN ROCKS.—Here are grouped the oldest known formations, embracing a vast thickness of highly metamorphosed rocks, associated with volcanic material, and also including limestones (Laurentian limestone of Canada, &c.) and well-developed mechanical sediments (sandstones and conglomerates of the Longmynd area in Salop, &c.). They are found in all parts of the world, and contain no undoubted fossils, though in the basin of the St. Lawrence, where they were first described (by Sir William Logan), a supposed reef-building foraminifer was discovered in the limestones and named Eozoön Canadense. Pre-Cambrian rocks crop out in various parts of Britain, especially in the Hebrides and the north-west part of the Scottish mainland, in which latter area some 10,000 feet of sandstone, &c. (*Torridon sandstone*), rests unconformably upon massive gneisses (fundamental or *Lewisian gneiss*). Probably a large part of the complex of schists and gneisses forming the Scottish Highlands is also of this age. Similar gneisses, &c., make up parts of the west and north of Ireland. Smaller pre-Cambrian exposures are seen in Charnwood Forest (Leicestershire), the Malvern Hills, Anglesey, and North Carnarvon, the St. Davids area, Salop, and elsewhere. In the last-named area a great volcanic series (*Uriconian*) makes up the high ground occupied by Caer Caradoc, the Wrekin, &c., while the Longmynd hills consist of a great thickness of sediments (*Torridonian*).

CAMBRIAN.—The rocks of this system, which owes its name to the fact that it was first worked out in Wales by the late Professor Sedgwick, rest with marked unconformity upon the pre-Cambrian, and are of special interest because they have yielded the oldest known undoubted fossils. Even at the base of the series, especially in North America, they include well-marked representatives of most of the great groups of animals at present existing, showing that these must have been evolved in still earlier

[1] × Line of dislocation and fault. The *throw* of the strata is down on the left, on the same side as the slope of the fault. Assuming any scale, the amount of the throw is found by measuring the vertical distance between the places where any bed from 6 to 12 abuts on the opposite sides of the fault. Beds 1 to 4 do not occur on the right of the fault, *having been removed by denudation.*

times. This goes to prove that the pre-Cambrian formations represent a vast amount of time, probably greater than that of all the other series put together; and should pre-Cambrian fossils ever be discovered, they may be expected to throw much light upon some of the problems of evolution.

Cambrian rocks are of singularly wide distribution, for they are found in many parts of Europe, especially the Baltic area, India, China, North America, South America, and Australia. The typical succession in North and South Wales, as determined by the researches of Sedgwick and the late Dr. Henry Hicks, is as follows:—

Tremadoc Slate.
Lingula Flags.
Menevian beds.
Harlech series. { Solva beds. Caerfai beds.

In establishing the chronological order of stratified rocks, more and more importance has been attached, as time has gone on, to the evidence obtained from fossils. The classical researches of Barrande among the older Palæozoic rocks of Bohemia have had much to do with this. He demonstrated that in that area three faunas of different kinds succeeded one another, and these coincide precisely with what are now called Cambrian, Ordovician, and Silurian. But palæontological work of this kind is now carried into much greater detail. It appears that certain genera and species have a comparatively small vertical range, and advantage is taken of this fact to draw boundary lines between 'zones' characterized by such forms and other associated fossils. In the case of the Cambrian, the fossils which have been used for this purpose are the remarkable organisms known as Trilobites (Plate II., figs. 2 and 8). These constitute an extinct group limited to the Palæozoic rocks, and presenting a great variety of genera and species. Their name is due to an obvious division of the body into a longitudinal axis and two side regions (Gr. *treis*, three; *lobos*, a lobe). There is a *head-shield*, upon which eyes are often present, a varying number of *trunk-segments*, and a *tail-shield* (*pygidium*), composed of few or many segments united together. Until quite recently scarcely anything was known about the limbs, these being delicate and unsuited for preservation; but the existence of a pair of jointed feelers (antennæ), four pairs of simple jaws, and numerous forked limbs on the trunk and tail, has now been established. The anatomical evidence is on the whole favourable to grouping these animals with the recent Crustacea. The genera Olenellus, Paradoxides, and Olenus characterize respectively the Caerfai beds, Solva and Menevian beds, and Lingula flags, and zones marked out by particular species have been demarcated in some cases.

The Welsh Cambrian formations are disposed in two areas, one north and the other south. The former consists essentially of two anticlinals placed in west Merionethshire and north of Snowdonia respectively, while the latter flanks the old pre-Cambrian ridge exposed in the St. Davids area. The gold-mines of Merionethshire are located among Cambrian strata.

The *Harlech series* consists of basal conglomerates, followed by grits, shales, and slates, and attaining a maximum thickness of some 10,000 feet. The leading fossils are as follows:—Species of Protospongia; burrows and trails of Annelid worms; the Brachiopods Lingulella primæva, L. ferruginea, Discina pileolus, and Orthis sagittalis; among Trilobites, fragments of Olenellus (?), species of Paradoxides and Conocoryphe, Microdiscus sculptus, and Plutonia Sedgwickii; Theca is (?) a primitive Gastropod.

The *Menevian beds* include not more than 600 feet of dark fine-grained shales, with the following fossils:—Protospongia; traces of Annelids; Protocystites, a cystoid Echinoderm; Orthis Hicksii and the Brachiopods found in the Harlech; Paradoxides Davidis, and species of the trilobite genera Conocoryphe, Anopolenus, Arionellus, and Erinnys; Theca corrugata and other Pteropod species.

The *Lingula flags* embrace more than 3000 feet of grits and slates, mostly accumulated in shallower water than was the case with the Menevian. The fossils include Dictyonema sociale, a colonial organism with numerous branches united into a net-work, and belonging to the extinct group of Graptolites, which later on attains great geological importance; traces of Annelids; a number of Brachiopods, among which Lingulella (formerly Lingula) Davisii (Plate II., fig. 1) is particularly characteristic, giving the name to the subdivision, Obolella Salteri, Orthis lenticularis, Kutorgina cingulata; among Crustacea the primitive form Hymenocaris vermicauda, probably related to the recent Phyllopods, and various species of Trilobite, as Olenus micrurus, Microdiscus punctatus, and Agnostus pisiformis; Bellerophon, a symmetrically spiral Gastropod, and species of Theca.

The *Tremadoc slate* forms the summit of the Cambrian system, and is some 1000 feet thick, consisting of slates which may be more or less calcareous. The fauna is to some extent of an intermediate character between that of the Cambrian and the succeeding Ordovician rocks, and the following fossils are typical:—Species of the Graptolites Dictyonema and Bryograptus; Orthis Carausii and species of Lingulella and Obolella; a sea-lily Dendrocrinus Cambrensis, and a star-fish Palæasterina Ramseyensis; numerous Trilobites, especially Angelina Sedgwickii, Asaphus Homfrayi, with species of Neseueretus, Niobe, Ogygia, and Psilocephalus; the bivalve Molluscs Glyptarca primæva, Ctenodonta Menapiensis, and Modiolopsis Ramseyensis; species of the primitive Gastropods (?) Theca and Bellerophon; and of the Cephalopod genera Orthoceras and Cyrtoceras.

The Cambrian rocks of the Welsh borders consist of a comparatively thin series of sediments flanking the Longmynd and the Malverns. They contain typical fossils, and the *Comley sandstone* of Shropshire has yielded numerous remains of Olenellus. The discovery of similar remains has also rendered it possible to refer certain beds in the north-west of Scotland to the lowest part of the Cambrian series. The rocks of Cambrian age described in various parts of the Continent are relatively thin, and this, among other reasons, has led to the belief now current, that the Welsh strata of this age were deposited near the eastern side of a continent which occupied all, or part, of the present North Atlantic area, this land being bounded on the east and west by extensive oceans of considerable depth, occupying more or less what are now Europe and North America. The Cambrian rocks of the latter continent present much the same succession as the corresponding deposits in Europe, but, as we might expect, their thickest developments are in the east, *i.e.* near the western edge of the old land. Numerous traces of volcanic action are found among the Cambrian rocks at different horizons.

The chief economic products of the system are roofing-slates, the best of which belong to the Harlech series, and are quarried at Llanberis and elsewhere.

Ordovician (*Lower Silurian* of the Geological Survey).—Our knowledge of these rocks as developed in Wales and on the Welsh borders is pri-

marily due to the labours of the late Professor Sedgwick, who included them in his Cambrian system. Unfortunately, however, Sir Roderick Murchison, a former director-general of the Geological Survey and founder of the Silurian system, which includes the next set of rocks to be described, failed to recognize the well-marked unconformity which exists at the base of the Llandovery rocks (see below), and therefore included Sedgwick's Upper Cambrian in that system. Hence arose an exceedingly bitter controversy, of little interest to the present generation of geologists, but which has undoubtedly created much confusion. Professor Lapworth has therefore proposed to call the rocks whose position was so much debated Ordovician (from a North Welsh tribe, the Ordovices), a practical suggestion which has found considerable favour; and it must therefore be borne in mind that the term is equivalent to Upper Cambrian as employed by Sedgwick, or Lower Silurian as defined by Murchison and the Geological Survey. These rocks, whatever name be adopted, are well characterized as being those which contain the *second fauna* of Barrande. Ordovician rocks are typically developed in Wales and on the Welsh borders, in the English lake district, and in the southern uplands of Scotland, also occurring in Cornwall and parts of Ireland. Outside Britain they have a wide distribution in Europe and North America, and some of the rocks of Australia and New Zealand are of the same age. The typical succession is as follows:—

Bala or Caradoc rocks.
Llandeilo series.
Arenig rocks.

Fossils afford valuable aid in the establishment of zones and larger divisions. Arenig and Llandeilo rocks contain abundant remains of species belonging to the Trilobite genus Asaphus, while the Bala rocks are similarly rich in species of Trinucleus; but these two genera are not absolutely confined to the series named, though most abundant there. Much greater help is in this case given by the dominant group of Graptolites, an extinct set of forms limited to the older Palæozoic rocks, and of low grade, being apparently akin to the hydroid zoophytes of recent seas (see Plate II., fig. 4). It has been found possible to divide both Ordovician and Silurian systems into a series of 'Graptolite zones' distinguished by particular species.

The Welsh Ordovicians are well developed both in the type-area of North Wales (Merionethshire and Carnarvonshire) and also in South Wales (shires of Brecon, Carmarthen, and Pembroke), some of the chief details being as follows:—

Arenig Rocks.—In North Wales these are represented by grits, shales, and slates, associated with thick lavas and ashes, the presence of which causes the ruggedness of the scenery in the ranges of Cader Idris, the Arans, and the Arenigs. The corresponding rocks in South Wales consist of a thick series of slates, and in the neighbourhood of St. Davids the upper part of these contain a peculiar fauna, and have been separated off under the name of *Llanvirn beds.* The chief fossils are as follows:—Numerous Graptolites, including Didymograptus bifidus, Diplograptus dentatus, Climacograptus confertus, Phyllograptus typus, and Tetragraptus bryonoides; species of Lingulella, Obolella, and Orthis; Æglina binodosa, Ogygia Selwynii, and other Trilobites; the bivalve Molluscs Redonia Anglica and Palæarca amygdalis; the primitive Gastropod (?) Conularia Homfrayi; and species of the Cephalopod genus Orthoceras.

The *Llandeilo series* in North Wales consists of a considerable thickness of black shales, and in South Wales of a much more considerable development of dark slates, in the middle of which a limestone is intercalated. The most typical Llandeilo fossils are the following:—Didymograptus Murchisoni, Cœnograptus gracilis, Dicellograptus sextans, Climacograptus bicornis, and other Graptolites; species of Lingula and Orthis; numerous Trilobites, especially Asaphus tyrannus (Plate II., fig. 2), Ogygia Buchii, Ampyx nudus, and Remopleurides radians; among Gastropod species Bellerophon perturbatus and Maclurea Logani.

The *Bala* or *Caradoc rocks* in the typical area round Bala Lake consist, as described by Mr. T. Ruddy, of shaly beds with a few thin ashes, and three limestones, named, in ascending order, after the localities of Bala, Rhiwlas and Hirnant. These limestones are the first well-developed beds of the sort found in the British succession, and they contain very numerous fossils. The picturesque scenery of the rugged Snowdonian area has been sculptured out of a complex synclinal of Bala rocks, here mainly consisting of a very thick series of lavas and ashes, with which a few thin sedimentary beds are associated. The top of Snowdon is formed by a calcareous ash believed to be equivalent to the Bala limestone. Passing to South Wales, we there find the lower part of the series represented by comparatively thin black shales in which numerous Graptolites are contained; and above these are three limestones, equivalent to those of the Bala district, and separated from one another by shaly beds. A very large suite of fossils has been described from the Bala beds, of which the following are the most characteristic:—Among Graptolites, Leptograptus flaccidus, Dicellograptus Morrisi, D. complanatus, Dicranograptus Clingani, D. ramosus, Climacograptus Wilsoni, C. bicornis, and Diplograptus foliaceus; some Corals, as Stenopora fibrosa and Chætetes petropolitana; numerous Brachiopods, such as Orthis biforata, O. caligramma, O. Actoniæ, O. alternata, O. testudinaria, O. flabellulum, Strophomena rhomboidalis, S. grandis, and Leptæna sericea; Cystoids, such as species of Sphæronites and Echinosphærites, Glyptocrinus basalis, and other Crinoids; the Trilobites include Asaphus Powisii, A. gigas, Trinucleus concentricus, Illænus Davisii, Phacops apiculatus, and Cheirurus Quenstedti; Gastropods are represented by Holopea concinna and Cyclonema rupestris; bivalve Molluscs by Ctenodonta semitruncata, Modiolopsis expansa, and Ambonychia prisca; while the Cephalopods include Orthoceras vagans and Lituites Hibernicus.

The Ordovician rocks of the Welsh borders conform, on the whole, to the North Welsh type. In the southern uplands of Scotland two types have been worked out and described by Professor Lapworth—(1) a series of ordinary sediments associated with volcanic rocks in the Girvan district; and (2) thin dark graptolitic shales of Llandeilo and Bala age in the Moffat area. The working out and correlation of these latter beds was a task of great difficulty, and could never have been effected had it not been for the establishment of Graptolite zones traceable from place to place. These thin deposits appear to have been formed in extremely deep water, which harmonizes with the fact that they contain scarcely any fossils but Graptolites, for we know that these organisms floated on the surface of the sea, attached, no doubt, in many cases to sea-weeds. Their horny skeletons were well adapted for preservation, while the shells, &c., of calcareous organisms would be dissolved before they could settle down on the floor of the deep

sea. These conclusions are confirmed by the association with the Scottish beds of cherts containing the remains of Radiolaria, and probably representing deposits similar to the Radiolarian oozes which are now accumulating on the floor of the deeper parts of the oceans. The Ordovician rocks of the Lake district, like those of North Wales, contain much volcanic matter, associated as usual with rugged and picturesque scenery. At the base are the *Skiddaw slates*, in the upper part of which occur numerous volcanic rocks, and which are of Arenig age. Above them comes an exceedingly thick volcanic series (Borrowdale series), equivalent in the main to Llandeilo, and upon this rests the Coniston limestone, which, together with the underlying *Dufton shales* and overlying *Ashgill shales*, is equivalent to the Bala, into which volcanic action continued locally.

During Ordovician times the North Atlantic continent spoken of in dealing with the Cambrian, appears to have persisted, no doubt with variations in outline, and the British deposits of the period were accumulated in a sea, deep in parts, which was studded with volcanic islands.

The chief economic products of the Ordovician are slates, which are quarried in the Arenig beds of Pembrokeshire and Merionethshire, and in the Llandeilo series at Ffestiniog and elsewhere. There are also Ordovician lead and silver mines in Merioneth, the Scottish Leadhills, and in the Shelve district of Salop. The once-famous plumbago mines of the Lake district are in the Borrowdale series, and phosphatic nodules, used in the preparation of artificial manure, are found in some abundance at the top of the Bala limestone in some localities in North Wales.

SILURIAN (*Upper Silurian* of the Geological Survey).—This system was first worked out by Sir Roderick Murchison in the type-area of South Wales and the Welsh borders, and is named after the South Welsh tribe of the Silures. The rocks of which it is composed usually rest with marked unconformity upon the older rocks (fig. 5), while above it gradually

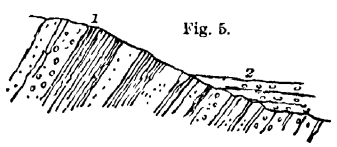


Fig. 5.

1. Cambrian rocks
2. Pentamerus limestone and conglomerate

merges into the overlying Old Red Sandstone beds. Silurian rocks sweep round the older strata of Wales in a continuous outcrop from near Carmarthen in the south to Conway in the north, and an important spur runs off as far as Coalbrookdale. They also cover a large area in central and southern Wales, and occur in outlying patches in parts of the west of England, as at Woolhope in Herefordshire, and Tortworth in Gloucestershire. We meet with them again in the English Lake district and in the southern uplands of Scotland, where they rest with apparent conformity upon the Ordovician rocks already described, though the two systems are sharply marked off by a palæontological break. Indeed it may be said that the boundary line between Silurian and Ordovician is one of the best marked in the whole geological record, which is in itself a sufficient reason for restricting the name Silurian to rocks above this break. There are many Silurian outcrops, some of considerable area, in Ireland. Rocks of the same system are widely distributed in Europe, and are particularly well developed in Scandinavia. They are developed in force in Canada and the United States, and have been recorded in South America, North India, Australia, New Zealand, and the Arctic regions. The typical Silurian succession is as follows:—

Ludlow	Upper Ludlow Aymestry limestone Lower Ludlow	Downtonian
Wenlock	Wenlock limestone Wenlock shale Woolhope limestone	Salopian
Llandovery	Tarannon shales Upper Llandovery Lower Llandovery	Valentian

The old-established names of Mayhill, Wenlock, and Ludlow series will be used in describing these strata; but the terms Valentian, Salopian, and Downtonian, suggested by Professor Lapworth, are often employed.

The Silurian system presents a strong contrast to the Ordovicians and Cambrians in the almost complete absence of contemporaneous igneous rocks; and the presence of well-marked limestones in Salop and North Hereford is another prominent feature. These limestones resist wear better than the associated shales, and denudation has consequently given rise to well-scarped scenery, the harder beds projecting as prominent ridges, of which Wenlock 'Edge' is an excellent example.

Just as the Ordovician is divisible into two parts, each characterized by the predominance of a particular Trilobite genus, so also in the case of the Silurian, for Harpes is prominently associated with the Llandovery series, and Encrinurus with the Wenlock and Ludlow series. Graptolites have lost their predominance, and die out before the upper limit of the system is reached, although a great part of it is divisible into Graptolite zones. One family of the group (Monograptidæ) is entirely limited to the Silurian. The fauna of the system (corresponding to Barrande's *third fauna*) is exceedingly rich, the most dominant groups being those of Corals, Echinoderms, and Brachiopods. The uppermost beds of the series contain the first undoubted Vertebrate remains, in the form of the scales and spines of fishes; and traces of land-plants are also met with for the first time.

It will be convenient to consider in the first place the succession obtaining in the Welsh borders and Wales.

May Hill Series.—In the border district the base of the series is formed by conglomerate and grit, the May Hill sandstone, which rests unconformably upon the older rocks, and is succeeded by the Pentamerus limestone, so named from the Brachiopod Pentamerus oblongus (Plate II., fig. 3), which is extremely common in it. This again is conformably succeeded by thin purple shales of Tarannon age. In South Wales there is a series of grits and shales of older age than the May Hill sandstone, and known as the Lower Llandovery; while in Central and North Wales the entire Llandovery series is a monotonous succession of mechanical sediments, and the Tarannon series in particular expands in Central Wales to a maximum of about 1000 feet. The chief Llandovery fossils are the following:—Numerous Graptolites, including Diplograptus acuminatus, Climacograptus normalis, Monograptus spiralis, M. gregarius, M. lobiferus, M. jaculum, M. Sedgwickii, M. turriculatus, and Rastrites peregrinus; corals belonging to the genera Petraia, Halysites, Favosites, Syringopora, and Heliolites; Atrypa hemispherica, Pentamerus oblongus, Stricklandinia lens, and other Brachiopods; the Echinoid Palechinus; Proëtus Stokesii, Acidaspis Brightii, and species of Harpes

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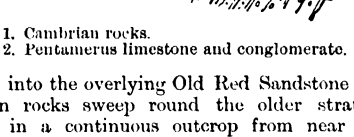


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Llandovery	Tarannon shales Upper Llandovery Lower Llandovery	Valentian

The old-established names of Mayhill, Wenlock, and Ludlow series will be used in describing these strata; but the terms Valentian, Salopian, and Downtonian, suggested by Professor Lapworth, are often employed.

The Silurian system presents a strong contrast to the Ordovicians and Cambrians in the almost complete absence of contemporaneous igneous rocks; and the presence of well-marked limestones in Salop and North Hereford is another prominent feature. These limestones resist wear better than the associated shales, and denudation has consequently given rise to well-scarped scenery, the harder beds projecting as prominent ridges, of which Wenlock 'Edge' is an excellent example.

Just as the Ordovician is divisible into two parts, each characterized by the predominance of a particular Trilobite genus, so also in the case of the Silurian, for Harpes is prominently associated with the Llandovery series, and Encrinurus with the Wenlock and Ludlow series. Graptolites have lost their predominance, and die out before the upper limit of the system is reached, although a great part of it is divisible into Graptolite zones. One family of the group (Monograptidæ) is entirely limited to the Silurian. The fauna of the system (corresponding to Barrande's *third fauna*) is exceedingly rich, the most dominant groups being those of Corals, Echinoderms, and Brachiopods. The uppermost beds of the series contain the first undoubted Vertebrate remains, in the form of the scales and spines of fishes; and traces of land-plants are also met with for the first time.

It will be convenient to consider in the first place the succession obtaining in the Welsh borders and Wales.

May Hill Series.—In the border district the base of the series is formed by conglomerate and grit, the May Hill sandstone, which rests unconformably upon the older rocks, and is succeeded by the Pentamerus limestone, so named from the Brachiopod Pentamerus oblongus (Plate II., fig. 3), which is extremely common in it. This again is conformably succeeded by thin purple shales of Tarannon age. In South Wales there is a series of grits and shales of older age than the May Hill sandstone, and known as the Lower Llandovery; while in Central and North Wales the entire Llandovery series is a monotonous succession of mechanical sediments, and the Tarannon series in particular expands in Central Wales to a maximum of about 1000 feet. The chief Llandovery fossils are the following:—Numerous Graptolites, including Diplograptus acuminatus, Climacograptus normalis, Monograptus spiralis, M. gregarius, M. lobiferus, M. jaculum, M. Sedgwickii, M. turriculatus, and Rastrites peregrinus; corals belonging to the genera Petraia, Halysites, Favosites, Syringopora, and Heliolites; Atrypa hemispherica, Pentamerus oblongus, Stricklandinia lens, and other Brachiopods; the Echinoid Palechinus; Proëtus Stokesii, Acidaspis Brightii, and species of Harpes

(especially in Sweden) among Trilobites; species of the Gastropod genera Euomphalus, Murchisonia, and Holopella, and of the Cephalopod genera Orthoceras and Cyrtoceras.

Wenlock Series.—In the southern part of the border area the base of this series is formed by the Woolhope limestone, which reaches a thickness of about 150 feet at Malvern. Above this, and forming the base of the Wenlock series in the northern borders, are the Wenlock shales, the most persistent subdivision of the group, of which the uppermost division is the Wenlock limestone. This attains a maximum thickness of about 300 feet, and is literally crammed with fossils. In North Wales the Wenlock series is represented by the Denbighshire grits, the thickness of which may be as much as 10,000 feet. Typical Wenlock fossils are the following:—Cyrtograptus Murchisoni, Monograptus colonus and M. priodon, with other Graptolites; a large number of Corals, some forming reefs, and including Omphyma turbinatum, Favosites Gothlandica, Heliolites interstincta, Halysites catenularius, Acervularia luxurians, and Cyathophyllum truncatum; some of the commonest Brachiopods are Rhynchonella Wilsoni, Atrypa reticularis, Strophomena euglypha, and Pentamerus galeatus; the Polyzoa include species of Fenestrella, &c.; Echinoderms are exceedingly abundant, Pseudocrinites quadrifasciatus is a typical Cystoid; while the Crinoids are represented by such forms as Actinocrinus pulcher, Crotalocrinus rugosus, Cyathocrinus pyriformis, and Taxocrinus tesseracontadactylus; among Crustacea and their allies are a barnacle, Turrilepas Wrightianus, and numerous Trilobites, especially Encrinurus punctatus and E. variolaris ('Strawberry-headed Trilobites'), Illænus Barriensis, Phacops caudatus, Calymene Blumenbachii (the 'Dudley Locust'), Homalonotus delphinocephalus, also Pterygotus problematicus, one of the first representatives of the extinct group of Eurypterida, probably akin to the recent King-Crabs; Molluscs are fairly abundant, such as the bivalves Cardiola interrupta and Pterinæa lineata; the Gastropods Euomphalus rugosus, Acroculia haliotis, Bellerophon dilatatus, and Conularia Sowerbyi; and Cephalopods, such as Orthoceras annulatum (Plate II., fig. 5), Gomphoceras pyriforme, and Phragmoceras ventricosum.

Ludlow Series.—The Lower Ludlow consists of shales and similar sediments, which are succeeded by the concretionary Aymestry limestone, and this again by the Upper Ludlow. The last exhibits shaly beds at the base; and resting upon these is a thin 'bone bed', made up almost entirely of the remains of fishes and Crustacea. The bone-bed is succeeded by the Downton sandstones and Ledbury shales ('Tilestones'), which grade into the Old Red Sandstone above. In North Wales the uppermost Ludlow beds are not developed, and the remainder are represented by shales and grits; while in South Wales the succession is similar to that of the borders, except that limestone is either absent or less pronounced. Among the numerous Ludlow fossils the following may be regarded as typical:—somewhat doubtful traces of land-plants have been discovered in the Upper Ludlow, supposed to be related to the recent Club-mosses, and also a problematic organism known as Pachytheca, consisting of spheres of about $\frac{1}{4}$ of an inch in diameter, with a radiating structure, variously interpreted as belonging to the Sea-weeds and the higher cryptogams; Graptolites die out in the Lower Ludlow, where they are represented by Monograptus Nilssoni, M. Ludensis (Plate II., fig. 5), M. Leintwardenensis, &c.; Corals are not abundant, except in the Aymestry, and they resemble those found in the Wenlock limestone; Annelid burrows are pretty common, including Serpulites longissimus and Cornulites serpularius; among Brachiopods many of the Wenlock species are to be found, and also such forms as Pentamerus Knightii (especially characteristic of the Aymestry limestone), Discina rugata, and Lingula cornea; true Crustacea are represented by Phyllopods (Ceratiocaris and Dictyocaris) and Ostracods (Beyrichia, Leperditia, Entomis); the waning group of Trilobites by many of the Wenlock species, with some few others; and the dominant Eurypterids, which appear to usurp the place formerly occupied by the last-named group, by numerous genera (Eurypterus, Hemiaspis, Pterygotus, Slimonia, &c.), some of which include species of large size; Echinoderms are represented by a number of the Wenlock Crinoids, by Star-fish such as Palæaster Ruthveni, and by Brittle-Stars (Protaster Miltoni, Palæocoma Colvini, &c.); Molluscs are on the increase, and include such bivalves as Cardiola striata, Avicula Danbyi, and Modiolopsis lævis; Bellerophon expansus, B. dilatatus, Euomphalus carinatus, Holopella obsoleta, and other Gastropods; and Orthoceras Ludense, O. bullatum, Lituites giganteus, and other Cephalopods; the numerous fish-remains of the bone-bed include species of Cephalaspis, Pteraspis, Scaphaspis, Plectrodus, and Thelodus.

The Silurian rocks of the English Lake district resemble those of North Wales in lithological character. The lower part of the Llandovery series finds its representative in the thin, dark *Skelgill shales*, with abundant Graptolites, and upon these are paler *Browgill shales* of Tarannon age. Wenlock and Lower Ludlow are represented by 6000 feet of sediments (*Coniston flags* and *grits*); while the rest of the Ludlow finds its equivalent in a still thicker mechanical series, the *Bannisdale slates* and *Kirkby moor flags*.

Silurian beds are well-developed in the south of Scotland, for our knowledge of which we are mainly indebted to Professor Lapworth. The complex folds which affect these rocks as well as the related Ordovicians has made the task of unravelling their relations a task of unusual difficulty, and here again Graptolite zones have been of the greatest assistance. In the Moffat area the Lower and Upper Llandovery are represented by the graptolitic *Birkhill shales*, only 100 feet thick, while the well-developed grits, flags, and shales of the *Gala series* are equivalent to Tarannon. The lithologically-similar *Riccarton series* represents Wenlock and Lower Ludlow, while the rest of the Ludlow series, including passage-beds, is paralleled by the *Lesmahagow series* of Lanarkshire.

The Silurian rocks of Scotland, the Continent, and North America have yielded interesting evidence concerning the nature of the terrestrial fauna of the period. Mr. B. N. Peach has described a fossil scorpion, Palæophoneus, from the Lesmahagow Silurian; and members of the same group have been recorded from France, Sweden, and the United States. Silurian insects have also been discovered, especially in the rocks of New Brunswick, which have also yielded the remains of Myriapods and Land-snails.

At the end of the Silurian period important uplifts of the earth's crust took place, that converted a large part of the British area into land, which was continued north and north-east. The elevatory movements were emphasized along certain axes, thus giving ridges of high land, between which sedimentation went on under the much-modified conditions dealt with under the Old Red Sandstone and Devonian. In Britain there were four chief lines of elevation: (1) across North Scotland to Scandinavia; (2) through North Ireland and the

southern uplands of Scotland; (3) in the English Lake-district; and (4) in Wales. In this way ended the Protozoic or Older Palæozoic period, including Cambrian, Ordovician, and Silurian, and the newer Palæozoic or Deutozoic time was initiated. The Invertebrate fauna lost its dominance in favour of the lower Vertebrates, and a luxuriant terrestrial flora, in which the leading part was played by the higher Cryptogams (Vascular Cryptogams), came rapidly into existence. As we have seen, both of these had their beginnings in the Protozoic, and in comparing this with the Deutozoic we must not forget that the terrestrial organisms of the oldest formations have been so seldom preserved that we know hardly anything about the land-life of the time they represent.

The Protozoic rocks are not only admirable examples of the way in which small subdivisions can be established and traced by means of zone-fossils, but they also illustrate the great complexity of the problems presented by the physical geology of mountain regions. An excellent instance of this is afforded by the 'Highland controversy' regarding the succession of rocks in the north-west of Scotland. This was first worked out by application of the rules applying to secondary strata, which in our area have been but little disturbed, and lie on the other in a sequence representing their relative geological age. At first sight the arrangement of the old rocks in Sutherlandshire presents a perfectly simple succession, and was interpreted by Murchison and others as follows, in descending order, from east to west:—

Old Red Sandstone of Caithness, &c., resting unconformably upon Metamorphosed Silurian rocks (Eastern gneiss, &c).
Cambro-Silurian rocks of Durness, Eriboll, and Assynt, including limestones, fucoid beds, and quartzites.
Cambrian sandstone of Torridon, &c.
Metamorphic Archæan rocks (Western or Lewisian gneiss, &c.).

This view was, however, challenged by the late Professor James Nicol of Aberdeen, who largely anticipated the opinions which are now universally adopted. As time went on, the investigations of many observers among pre-Cambrian rocks, and of those who worked in such disturbed mountain areas as Switzerland, demonstrated that in such cases crust-movements have folded and faulted the rocks in such a way as to reverse the succession. Over-faults of slight inclination to the horizontal have caused older rocks to be thrust upon younger ones with an often deceptive appearance of conformity. Professor Lapworth and others applied the rules of mountain structure to North-west Scotland, and were able to prove that the succession believed in by Murchison is not in accordance with facts; and though their opinions were at first regarded as heterodox, they have since been fully established and worked out in detail by the officers of the Geological Survey. The discovery of Olenellus in the lower part of the series termed Cambro-Silurian above has proved them to be of Cambrian age, and the Torridon sandstone is consequently relegated to the pre-Cambrian series. The geological sequence of the various beds given in the old grouping is now held to be as follows:—

Old Red Sandstone.
Cambrian limestones, fucoid beds, serpulite grit, and quartzites.
Archæan { Torridon sandstone. / Eastern gneisses and schists. / Western gneiss.

The stratigraphical relations are diagrammatically represented in fig. 6 (after Lapworth). The thickness of the Cambrian rocks in the Durness district has been estimated at about 2000 feet.

The Northern Highlands are mainly made up of the Eastern or Caledonian gneisses mentioned above, and they consist of gneisses and schists with intruded igneous rocks. The Grampian Highlands farther south consist of a bewildering complex, to which the name of *Dalriadian* has provisionally been given. They include not only schists and the like, but also unfossiliferous sediments which in

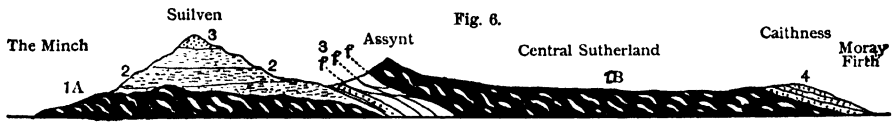


Fig. 6.

Gneiss: 1. Altered Archæan (1A, Western or Lewisian; 1 B, Eastern or Caledonian Gneiss). 2. Unaltered Archæan (Torridon sandstone). 3. Cambrian. 4. Old Red Sandstone. *fff* Thrust Planes.

some cases have undergone but little alteration, and probably include not only Archæan, but also Protozoic rocks.

Old Red Sandstone and Devonian.—Where the uppermost Silurian strata join the Old Red Sandstone there is a gradual passage between them. The Eurypteri and Pterygoti chiefly belong to these passage-beds, and in the same strata and at the very base of the Old Red strata, in which there are no mollusca, are species of fish of the genera Auchenaspis, Onchus, Pteraspis, Cephalaspis, and Plectrodus. The Silurian marine mollusca quickly disappear where the red beds begin, notwithstanding the perfect conformity of the two sets of strata in England and the borders of Wales. The *Old Red Sandstone* first received that name in contradistinction to the *New Red Sandstone*, the former occurring below, and the latter above the Carboniferous strata.

A broad belt of Old Red Sandstone crosses Scotland in a north-east direction between the Firth of Clyde and Montrose and Stonehaven. North of this, detached patches skirt the gneissic Highland rocks on the east coast of Scotland, forming both shores of Moray Firth, and extending up to the Pentland Firth, the Orkneys, and part of the Shetland Islands. Patches lie in Arran, Bute, &c. The broad tract between the Clyde and Stonehaven lies in most places unconformably on older strata, and dips to the south-east under the *Carboniferous rocks* that occupy the great central depression through which the Forth and Clyde chiefly run. On the south-east side of this broad undulating hollow the Old Red Sandstone again rises from beneath the *Coal-measures* with a general north-west dip, and, skirting the Lammermuir Hills, strikes south-west into the sea south of Ayr. On the south side of the Lammermuirs it again appears on the hills between Berwick and Hawick, dipping under the Carboniferous rocks that, without a break, stretch from Berwick to the neighbourhood of Derby. In Westmoreland and Cumberland, strips of Upper Old Red conglomerate occasionally occur.

For the first compendious account of the Old Red Sandstone of Scotland the world is indebted to

Hugh Miller, whose wonderful faculty of graphic description enabled him, unassisted, to describe the rocks and the remarkable forms of fish they contain, which till his time were almost altogether unknown. Something, however, still remains to be done before the precise relations to each other of some of the parts of the Old Red Sandstone are clearly established. Conglomerate often lies at the base of any part of the sandstone that rests directly on the ancient slates and gneissic and granitic rocks. This is sometimes thin and sometimes of enormous thickness. It is also frequently very coarse, containing both water-worn and subangular fragments of the underlying rocks from the waste (denudation) of which it has been formed. Some of the fragments have been observed of a yard in diameter. It stretches across Scotland from Stonehaven to the Clyde. The ancient gneiss of the Grampian Hills is much older than the Old Red Sandstone, and the same may be said of the Lammermuirs, both of which were disturbed and denuded to form the vast conglomerate of old Red rocks south of Dunbar. Some of these brecciated conglomerates were considered by Ramsey to be glacial boulder-beds. The lower conglomerates are often surmounted by sandstone and bituminous schist, containing fish of the genera Dipterus, Coccosteus, Pterichthys, Diplacanthus, and Osteolepis. These rocks are sometimes overlaid by beds of red marl, red and variegated sandstone and conglomerate, and gray and yellow sandstone containing on various horizons Holoptychius nobilissimus, Cephalaspis Lyellii, &c. The uppermost beds of yellow sandstone at Dura Den, in Fife, abound in Glyptopomus, Pterichthys (P. Milleri, Plate II., fig. 6), Holoptychius, Pamphractus, &c. At the top the Old Red Sandstone seems in this and in other places to pass into the lower rocks of the Carboniferous series, containing Holoptychius Hibberti, plants, &c. In these uppermost so-called Old Red beds, both in Scotland and Ireland, there occur a fern, Adiantites Hibernicus, and a fresh-water bivalve shell, Anodonta Jukesii.

In North Wales and Cumberland narrow streaks of red sandstone here and there show themselves between the Silurian rocks and Carboniferous limestone. South of Coalbrookdale it ranges, in great force, through parts of Shropshire, Herefordshire, and Gloucestershire, into South Wales, where it stretches westward to the west coast of Pembrokeshire. The whole series, between the Silurian rocks near May Hill and the Carboniferous limestone of Dean Forest, is about 8000 feet in thickness. The lower part is chiefly composed of beds of red marl and sandstone, with cornstones; and the upper part contains strata of sandstone and conglomerate, forming the Beacons of Brecon, 2860 feet high, being the loftiest mountains in South Wales. Cornstones are impure concretionary limestones, often embedded in marl. In the cornstones at the base are species of Pterygotus and Pterichthys near Ludlow, and higher up, of Onchus and Cephalaspis, thus uniting them by fossils to the Old Red Sandstone of Scotland.

The absence of marine shells, and the nature of the fossil fishes of the Old Red Sandstone, indicate that the formation was deposited, not in the sea, but in a great fresh-water lake, or in a series of lakes, for the nearest living analogues of many of the fish are the Polypterus of the African rivers, the Ceratodus of Australia, and in less degree the Lepidosteus of North America. The red colour of the rocks also helps to the same conclusion. Each grain is red because it is incrusted with a thin pellicle of peroxide of iron, which could not have been deposited in a great open ocean from solution; but if carbonate of iron were carried in solution into lakes, it might have been precipitated as a peroxide through the oxidizing action of the air and the escape of the carbonic acid.

In 1836, Sedgwick and Murchison described the existence in Devonshire of a series of rocks bearing fossils intermediate in character between the Upper Silurian and those of the Carboniferous limestone, and on these and certain stratigraphical grounds it was considered that they are the equivalents of the Old Red Sandstone of the west of England and of Scotland, and the name DEVONIAN being applied to them, the terms Devonian and Old Red Sandstone are generally considered equivalent in point of time.

In Devonshire the rocks have been divided into *Lower*, *Middle*, and *Upper Devonian*. The lower beds chiefly consist of slaty beds, and green and purple sandstones, with shells (Brachiopoda) of the genera Chonetes, Orthis, Spirifer, &c. The middle group, which includes the Plymouth limestone, contains numerous corals; the most common of which are Acervularia, Alveolites, Cyathophyllum, Favosites, Petraia, Strephodes, and Stromatopora. With these are found Encrinites, Spirifers, Atrypas, Leptænas, Producti, Rhynchonellæ, Stringocephalus, and Calceola (C. sandalina; see Plate, fig. 7)—the last a coral peculiar to the Devonian rocks. Many Lamellibranchiate molluscs also occur, together with Gastropoda of the genera Euomphalus, Loxonema, Machrocheilus, Murchisonia, Pleurotomaria, Turbo, &c. Also many Cephalopoda of the genera Clymenia, Cyrtoceras, Orthoceras, and Goniatites and Nautilus. Clymenia is limited to Devonian strata, in which Goniatites appears for the first time. The other three range from older rocks. The Goniatite is intermediate in structure between the Nautilus and Ammonite. The latter does not occur in Palæozoic strata. Trilobites are found in the Devonian rocks, and various Crinoids. The Upper Devonian group contains land plants (Stigmaria, &c.), and many shells, some of which are identical with those found in the Lower Carboniferous limestone shales.

There is in England a considerable diminution in the number of Devonian fossils compared with those of the Silurian rocks, and it must be remembered that those of the latter are chiefly marine, while those of the former include terrestrial and fresh-water forms from the Old Red Sandstone. The corals in the Devonian rocks are, as regards genera, not greatly inferior in numbers to those of the Silurian, to which nearly half are common. Of the Echinoderm genera pretty nearly a third are found in the underlying Silurian, a proportion somewhat exceeded by the Crustacea, including those found both in the Devonian rocks and the Old Red Sandstone. In the latter no Trilobites occur, but only Crustacea of the genera Eurypterus, Pterygotus (and eggs), and Stylonurus, while in the Devonian formations of Devonshire we find a number of Trilobites:—Bronteus (B. flabellifer, fig. 8), Cheirurus, Phacops Homalonotus, and Harpes, common to the Silurian strata, though the species are distinct. Nearly half of the Devonian genera of Brachiopoda occur in Silurian rocks; but of Devonian *species* few pass downwards, and these are doubtful. The most prevalent genera of Brachiopoda are Athyris, Atrypa, Cyrtina, Orthis, Rhynchonella, Spirifer, Streptorhynchus, and Terebratula. Species of the genera Leptæna and Pentamerus decline in numbers, while Orthis, Rhynchonella, and Spirifer are much increased. Lamellibranch molluscs are fairly common in the Devonian, but the species are all, or almost all, distinct from those of Siluria, while but few of the genera are the same.* The most prevalent

forms are Aviculopecten, Pterinea, Cucullæa, Ctenodonta, and Curtonotus. Megalodon is characteristic. Of the Gastropod genera over half are Silurian, but the species are all distinct. The most prevalent forms belong to the genera Euomphalus, Loxonema, Machrocheilus, Murchisonia (but less common than in the Silurian rocks), and Pleurotomaria. There are several species of Bellerophon, and many of Cephalopoda, all distinct from Silurian species. Of Devonian genera, only Orthoceras, Poterioceras, and Cyrtoceras are Silurian. The most prevalent species belong to the genera Clymenia, Cyrtoceras, Goniatites, which in Britain first appear, and Orthoceras. Fish have amazingly increased (chiefly found in the Old Red Sandstone of Scotland). A rich Devonian flora, with associated insects, myriapods, &c., has been described in North America.

The Devonian strata are well developed in Belgium, the Eifel, on parts of the Rhine, in Spain, North Germany, and in Russia from the shores of the Baltic to the Ural Mountains. They are there described by Murchison as containing the shells of Devonshire, and an Old Red Sandstone fish of Scotland in the same beds. In Asia they are known in the Himalaya and China; in Africa, at the Cape of Good Hope; and in North America they occur largely in the Upper Helderberg Portage and Chemung series, which is overlaid by the so-called Old Red Sandstone of the Catskill Mountains.

CARBONIFEROUS ROCKS.—In the south and middle of England, and in Ireland, the CARBONIFEROUS ROCKS consist chiefly of limestone at the base and Coal-measures above. Including the South Wales, the Forest of Dean, and the Somersetshire areas, a typical section of the beds is as follows:—

	Feet.	Feet.
Coal-measures	1000 to	12,000
Millstone grit	500 ,,	1,000
Yoredale rocks	100 ,,	1,000
Carboniferous or Mountain limestone	500 ,,	2,500
Carboniferous limestone shale	100 ,,	500
Yellow sandstone, with plants, Ireland, &c.	100 ,,	200
Generally resting on Old Red Sandstone.		

The *Yellow sandstone* beds form a kind of passage from the Old Red Sandstone to the Carboniferous rocks, and the plants have Carboniferous affinities. The overlying *shales* in Pembrokeshire, &c., contain numerous fish-teeth, Spirifers, Productas, and a few Lingulas; and the *limestone*, which is more than 2000 feet thick in South Wales, near Bristol, and in Somersetshire, is also so highly fossiliferous that it may be stated that the whole of the limestone has once formed parts of animals. The lowest 500 feet consists largely of rings of Encrinites. The *Yoredale rocks* of Yorkshire consist chiefly of shales and sandstones, with marine shells and occasional land-plants. The *Millstone grit* of South Wales is comparatively unfossiliferous, but sometimes contains the remains of plants, and more rarely marine shells.

The *Coal-measures* and *Millstone grit* of Monmouthshire, Glamorganshire, and Pembrokeshire lie in a great oval basin, encircled by a rim of limestone, beneath which lies the Old Red Sandstone. The Coal-measure beds alone were estimated by Sir William Logan at from 10,000 to 13,000 feet thick. They consist of alternations of sandstone, shale, fireclay or underclay, coal, and ironstone. There are about 100 beds of coal in the field, many of which are workable, chiefly in the lower part of the series, where the principal ironstones also occur. In the shales and sandstones large stems of plants are sometimes found standing vertically, in the positions in which they grew. Underneath each bed of coal is a bed of underclay with Stigmariæ, forming the soil in which the plants were rooted, by the decay of which, passing into peat, material was supplied for the production of coal. Stigmaria, once supposed to be a peculiar plant, was first proved by Mr. Binney to be the root of Sigillaria (shown in fig. 10). These roots and rootlets are in every bed of underclay. Passing from east to west, the coals (sometimes the very same beds) gradually change from so-called bituminous to anthracitic varieties. It is remarkable that anthracite usually occurs in coal-fields the strata of which have been much disturbed and contorted, and sometimes metamorphosed, as, for instance, in the mountains of Pennsylvania. Anthracite is simply a metamorphic variety of coal; and in Pembrokeshire, where the coals are most anthracitic, the Coal-measure strata have been violently contorted. There is a connection between the heat that produced metamorphism and the lateral pressure that produced contortion, for pressure with movement is converted into heat. A line of disturbance passes from the banks of the Wye, south of Builth, through the north part of the coal-field south of Llandeilo, and from thence westward into Pembrokeshire, where syenites, &c., appear in contact with the coal-field. In connection with this it may be that the rocks of the coal-field remained a long time highly heated, and so, by a species of distillation, deep under-ground, the bituminous were converted into anthracite coals.

Dean Forest may be looked on as an outlier of the South Wales coal-field. The limestone is about 700 feet thick, and the Coal-measures, according to De la Beche, 2765 feet. The limestone contains brown hæmatite iron ore in cavernous holes. There are in the field twenty-three chief beds of coal. The Gloucestershire and Somersetshire coal-field was also originally joined to the South Wales Carboniferous rocks, till separated by denudation. The limestone series near Bristol, and on the Mendip Hills, is about 2500 feet thick, containing the usual fossils in great variety. The Coal-measures of the Bristol and Somersetshire coal-field lie in a basin of this limestone. They are altogether about 7000 feet thick, and consist of an upper and a lower series, separated by thick beds of grit, called the Pennant rock, about 2000 feet in thickness, and which itself holds beds of coal, some of them of value. Altogether they contain about forty-six beds of coal, with a total thickness of about 98 feet. A large part of this Carboniferous basin is covered by New Red marl and Liassic and Oolitic strata, and here and there portions of the coal-field are exposed by the denudations of the New Red marls between Bristol and the Mendip Hills, where the beds rise rapidly, and a narrow strip of Coal-measures skirts the Mendip limestone, the whole dipping north at high angles. Similar Coal-measures probably underlie the marshes, and part of the secondary strata south of the Mendips. The Culm-measures of Devonshire, though of true Carboniferous age, and perhaps representing the whole series, are nearly unproductive of coal.

The Forest of Wyre is a poor coal-field. It consists of upper Coal-measures, which rest directly on the Old Red Sandstone. The Coalbrookdale coal-field on the south lies partly on a thin development of Carboniferous limestone, and partly unconformably on Silurian rocks. On the north-west the lower part of the *New Red Sandstone* is faulted against it, and on the east it is overlaid by the *Permian rocks*. It contains several bands of nodular ironstones. There are in places twenty-two beds of coal, about ten of which are workable. The whole of these Coal-measures are about 1000 feet thick. The North Wales field lies on a great thickness of Carboniferous limestone. South of Wrexham the whole dips east

under the Permian rocks, and farther north under the New Red Sandstone. The Denbighshire part contains at least seventeen beds of coal, most of which are worked, and the Flintshire part at least twelve beds. A smaller development of the same strata occurs in the central part of Anglesey. It is underlaid by the Carboniferous limestone, and on the south-east is faulted against the Cambrian rocks. Permian strata overlie it in an unbroken sheet.

The basement beds of the South Staffordshire coal-field rest directly on eroded Silurian rocks. This field, in the northern part, contains fourteen beds of coal. In the south, several of these coalesce to form the thick coal, in places 40 feet in thickness, with two thin partings. The rocks are pierced by basalts and a white felspathic-looking trap, which alters the coals at the points of junction. The Warwickshire coal-field is faulted against the New Red Sandstone on the east, and generally overlaid by the Permian rocks on the west. It contains six beds of workable coal, besides ironstone, and on the south, where they pass under the Lower Keuper Sandstones, several of these coalesce. The Leicestershire coal-field is overlaid by the New Red Sandstone, and partly underlaid by the Carboniferous limestone, and partly, probably, by a continuation of the ancient rocks of Charnwood Forest. It is divided into two districts or basins: the eastern containing fifteen beds of coal, eleven of which are workable, and the western eleven beds. Nine are of superior quality. The Shropshire, South Staffordshire, and Warwickshire coal-fields present so many points of resemblance that undoubtedly they were all originally formed as one coal-field, and even now in great part may be continuous in the districts that lie between, covered by Permian and New Red strata.

North of this coal-field the Carboniferous rocks are somewhat modified in details. Between Derbyshire and Berwick they stretch north and south without a break for 200 miles by about 60 miles in width. At the southern end, near Derby, the New Red Sandstone overlies them. West of Cheadle they are generally faulted against the Permian rocks. The Carboniferous limestone and Millstone grit rise in the centre, forming the hills of Derbyshire; and the Coal-measures are thrown off on either side of the anticlinal axis, forming, in the east, the Derbyshire and Yorkshire coal-field, and on the west those of North Staffordshire and Lancashire. Three or four beds of igneous rock, called toadstone, lie in the limestone. The Millstone grit is much mingled with shale, and between it and the limestone there are often thick beds of shale and sandstone, called the Upper Limestone shale, or *Yoredale rocks*. North of the Ribble the Carboniferous limestone itself is divided by numerous interstratifications of sandstone and shale, with occasional beds of thin coal, and this increasing in the northern parts of Northumberland, the equivalents of the southern limestone fairly pass by degrees into a lower less-productive coal-field.

The Lancashire and Cheshire and North Staffordshire coal-fields, exclusive of the Millstone grit, vary from about 3500 to 7500 feet in thickness, counting from the beds on which the unconformable Permian strata happen to rest, and including about 46 coal-beds in North Staffordshire, in Lancashire 14 good seams about St. Helens, 15 at Wigan, 16 between Manchester and Bolton, and 13 at Burnley. Many of these, which in different districts go by different names, are equivalent beds. Fish remains and many marine and estuarine or fresh-water shells occur among the interstratified shales and sandstones. There are also many beds of ironstone. The Nottingham, Derbyshire, and Yorkshire coal-fields united give about 15 beds of workable coal. All these are ironstone areas, and North Staffordshire is the great pottery district of England. The finer clay is imported, only the coarser qualities for tiles, &c., being native. The Newcastle coal-field is about 1600 feet thick, and contains about 16 beds of coal throughout the district. The lower coal-field of Northumberland, as already stated, is of the date of the Mountain Limestone, and the Berwickshire coals are of the same general age. A smaller coal-field overlies the Carboniferous limestone north-east of Whitehaven, in Cumberland. There is a small coal-field near Ingleton in North Lancashire which contains 8 beds of coal, and in Cumberland the Whitehaven Coal-measures, which lie on the Carboniferous limestone, have 14 beds of coal.

The great Scottish coal-fields lie in a broad synclinal hollow, in which are the valleys of the Clyde and Forth. The whole tract is about 100 miles in length by 40 to 50 in breadth. The lower Carboniferous strata are much intermingled with igneous rock, sometimes felspathic, sometimes augitic. Some of these are intrusive, but the larger masses are truly interbedded lavas, associated with strongly-marked and thick strata of volcanic ashes and conglomerates. The Carboniferous limestone which overlies the Calciferous sandstone does not lie in a mass at the base of the Coal-measures, but, as in the North of England, occurs in several beds, chiefly in the lower part of the series, and interstratified with beds of sandstone, shale, and occasionally of coal. In Linlithgowshire and the Campsie Hills, limestones are interbedded with basalts, trachytes, and other volcanic rocks. In some cases in East Lothian, beds of fire-clay, with Stigmariæ, and thin layers of coal lying on old terrestrial soils, immediately underlie marine limestones with Productas. In the Dalkeith coal-field valuable beds of coal, with shales, &c., are interstratified with a thick series of beds of Carboniferous limestone. The Burdiehouse brackish limestone in East Lothian is the lowest of the limestones, and yields many small bivalve Crustacea of the genus Estheria, besides fish of the genera Megalichthys and Holoptychius. In the East and Mid Lothian coal-fields about twenty beds of workable coal occur, besides many smaller layers. Eleven workable beds of coal are known above the Millstone grit or Moor rock, and seventeen associated with the Carboniferous limestone beds below the grit. The Carboniferous strata of the Lothians cross the Firth of Forth beneath the sea, and form great part of Kinross and Fife, where there are twenty-nine workable beds, one of which is 21 feet, and others from 5 to 9 feet in thickness. The western part of the basin, in Lanarkshire and Ayrshire, yields eight or ten workable coal seams. It is in these districts that the well-known *black-band ironstones* occur.

By far the larger part of the surface of Ireland, from the southern coast to Lough Neagh and Donegal Bay, consists of the Carboniferous Limestone series, lying sometimes on Old Red Sandstone, sometimes on Silurian rocks. Here and there patches of Millstone grit and Coal-measures overlie the limestone. The largest area of this kind is in Kerry, Limerick, and Clare; the next, in Queen's County, Kilkenny, and Tipperary. In both of these there are coal-fields of no great extent in which the coals are anthracitic. There are also small coal-fields in Leitrim, Tyrone, and Antrim, in which the coals are bituminous. These coal-fields generally lie on high detached tablelands, and are merely the relics of one great coal-field that originally overspread the Carboniferous limestone of Ireland.

The same kind of original continuity may also be inferred concerning all the English coal-fields of the middle of England and northward to Cumber-

land and Northumberland, and the latter was even probably joined to the coal-fields of Scotland. After the close of the Carboniferous epoch, this great area was thrown into a series of undulating anticlinal and synclinal curves, great denudations occurred, and the result was that the individual coal-fields now lie in basins often separated from each other by intervening tracts of Millstone grit and Carboniferous limestone. Sometimes portions of these basins are concealed by unconformable overlying Permian and New Red strata. Thus, the Northumberland and Durham coal-field is probably a basin, partly out at sea, and the southern edge of which is overlaid by Magnesian limestone. The Yorkshire and Derbyshire coal-field is another basin, the eastern half of which must crop up against the Magnesian limestone, deep under-ground, and miles to the east of where it first dips beneath that limestone, and the Lancashire and North Wales coal-fields also form parts of one great basin in places probably 6000 feet or more beneath the New Red marl of Cheshire.

Respecting the manner in which coal was produced, it may be briefly stated that the underclays (which are often fire-clays) that lie beneath each bed of coal are full of Stigmarias, which were the roots of Sigillarias and other plant remains. These clays were the soils on which the plants grew, the progressive death and decay of which formed beds of peat, afterwards by pressure and chemical modifications to be turned into coal. If, then, a coal-field be thousands of feet thick, and if from bottom to top it contains many beds of coal, it is plain that the lowest bed once formed a land surface with vegetable growth; that submergence and the deposition of new sediments above the vegetable matters followed, that by and by a new soil and another growth of plants succeeded; and so on till the topmost bed of decayed vegetation and the topmost strata of the overlying Coal-measures were formed. Deep under-ground, and subject to great pressure, the peaty matter slowly passed through the stage of lignite, and finally was converted into various kinds of coal.

One other point must be mentioned. Though locally the Carboniferous rocks easily divide themselves into formations, such as Carboniferous limestone, Coal-measures, and the like, yet in reality they simply form one great formation, which in one place was being formed in the sea, as marine shales, sands, and limestones, while at the same time very broad continental land growths were going on in adjoining areas.

In the Carboniferous rocks more than 500 species of fossil plants have been named, a large proportion of which are ferns, including some tree-ferns. The most common genera are Sphenopteris, Pecopteris, Neuropteris (N. gigantea), Cyclopteris, Odontopteris, Caulopteris (tree-fern), &c. The remaining chief plants are Calamites, Lepidodendron (tree Lycopodiums), and Sigillaria (see illustrations in Plate II., figs. 10, 11, 12). Coniferous trees, the fruit of which is Trigonocarpum, also occur. In the Coal-measure strata there have also been found fresh-water Crustacea of the genus Cypris, a land shell (Pupa) in Nova Scotia, fresh-water bivalves, wings and wing-cases of beetles and other insects, spiders, &c. Rain-pittings on the shales are not infrequent, together with sun-cracks and footprints of Labyrinthodont Amphibia, Dendrerpeton, Anthracosaurus, and other genera.

If we now turn to the purely marine series, of which the Carboniferous limestone forms the most important part, we find that a considerable number of genera and species of Corals have been named. Among the most common are Cyathophyllum, Clisiophyllum, Syringopora, Lithodendron, Lithostrotion, and Zaphrenites. Crinoidea are very numerous, the most common of which belong to the genera Actinocrinus, Cyathocrinus, Platycrinus, and Poteriocrinus; primitive Echinoids (Archæocidaris, &c.) also occur. Trilobites are scarce in the Carboniferous rocks, the most characteristic genera of which are Griffithides and Phillipsia. Among other Crustaceans there are Estheria, Eurypterus, and Limulus. Polyzoa are numerous. Brachiopoda are also exceedingly numerous, the most strikingly characteristic of which are Productus and Spirifer (P. giganteus and S. striatus, figs. 13 and 14); Rhynchonella, Terebratula, and Athyris are also abundant. The genus Orthis persists, but in greatly diminished numbers. There are very numerous genera and species of Lamellibranchiate molluscs, which, unlike their development in the older rocks, in this formation far exceed the Brachiopoda, both specifically and generically, indicating a remarkable approach to the types of Secondary times, in which Lamellibranchiate molluscs by far predominate. The most common of these are Aviculopecten, Posidonomya, Arca, Conocardium, Edmondia, Modiola, Nucula, and Sanguinolites. Gastropoda are also represented by numerous forms, among which are many species of Euomphalus (E. pentangulatus, fig. 9), Pleurotomaria, and many species of Bellerophon (B. hiulcus, fig. 15). Cephalopodous species abound, the chief of which are Goniatites (G. sphericus, fig. 16), Nautilus, and Orthoceras. Very numerous genera and species of fish have been described, some of which probably lived alike in the sea and in fresh and brackish water.

Coal-fields occur in France, Belgium, Germany, Hungary, Russia, India, China, Borneo, New Zealand, Australia, &c. The largest known coal-fields in the world are in the United States and China. There are important coal-fields in New Brunswick and Nova Scotia.

The PERMIAN series succeeds the Carboniferous rocks. These were long considered as part of the New Red Sandstone, till separated from it by Professor Sedgwick, in his celebrated memoir on the Magnesian Limestone. They were first called *Permian* by Sir Roderick Murchison, from the government of Perm, in European Russia, where they largely occur. They are also largely and typically developed in the Thüringerwald. In Professor King's comparison of the German and British Permian rocks of the east and north of England, he arranges the Limestone series as follows:—

	North of England.	Thuringian.
Magnesian Limestone.	Crystalline and other limestone.	Stinkstein.
	Brecciated limestone.	Rauchwacke.
	Fossiliferous limestone.	Dolomit.
	Compact limestone.	Zechstein.
	Marl slate.	Kupfer Schiefer.
		Rothes Todtliegendes.

Between the north of the Tyne and the neighbourhood of Nottingham these rocks, nearly as above, skirt the Carboniferous rocks, and lie on them unconformably, but the subdivisions are not always clear. The limestones are sometimes fossiliferous. In Lancashire and Cheshire the Permian rocks chiefly consist of red marl and sandstone. Near Manchester, these, with a few bands of Magnesian limestone, contain shells of the genera Pleurophorus, Bakevellia, and Schizodus (S. Schlotheimi, Plate II., fig. 17). Permian strata, consisting of red marls, sandstone, and calcareous conglomerates, overlie the Coal-measures of Warwickshire.

A few stems of trees have been found in them, together with Calamites; and two or three casts of shells allied to Strophalosia, together with a Labyrinthodont Amphibian Dasyceps Bucklandi. The same rocks generally skirt the South Staffordshire coal-field, and in the Clent and Bromsgrove Lickey Hills they are capped by a remarkable brecciated conglomerate, consisting of pebbles and large blocks of stone generally angular. These conglomerate beds are about 400 feet thick. The south part of the North Wales coal-field, and the east side of Coalbrookdale, is also bordered by Permian marls and sandstones. South of Coalbrookdale, near Enville, and between that country and the Abberly and Malvern Hills, the same rocks occur largely associated with coarse brecciated conglomerates, similar to those of the Clent Hills. The fragments have mostly travelled from a distance, apparently from Wales and the Welsh borders. In Thuringia the conglomerates of the Rothliegende have the same lithological character as the brecciated conglomerates of the Abberly Hills and Clent Hills, and they may be considered equivalents both in position and origin.

The fossils of the Permian group are generically and specifically few in number, but as a whole their affinities and grouping are decidedly Palæozoic. Some of the plants have a Coal-measure aspect, including such genera as Calamites, Lepidodendron, Neuropteris, Sphenopteris, and Alethopteris, besides Walchia, Ullmannia, Cardiocarpon, and fragments of coniferous wood. There are some few Brachiopods, partly belonging to genera which also occur in the Carboniferous rocks, a somewhat larger number of Lamellibranchiate molluscs, the most common of which are of the genera Schizodus, Gervillia, Solemya, &c.; Gastropods, Nautili, and many ganoid fishes, the most common belonging to the very characteristic genus Palæoniscus (P. comptus and scale are seen in fig. 18). All the Permian fish have heterocercal tails, like the majority of the Palæozoic genera, in which the vertebral column is prolonged into the upper lobe of the tail, whereas in modern bony fishes the vertebral column is not prolonged into either lobe. The 'reptilian' remains, both of the red rocks and of the Magnesian limestone, are partly Amphibian, as shown by the Labyrinthodont Dasyceps Bucklandi of Kenilworth, the footprints in the red Permian sandstones of the Vale of Eden, and Corncockle Moor in Dumfriesshire, and Lepidotosaurus Duffii of the lower part of the Magnesian limestone; while others from the marl-slate, Proterosaurus Speneri and P. Huxleyi were true land reptiles.

Excepting the Magnesian limestone, all the Permian rocks are red. As with the thin pellicle of peroxide of iron that encrusts the grains of sand and mud of the Old Red Sandstone, so the colour of the red Permian sandstones and marls must have been due to the precipitation of peroxide of iron in inland waters, and the land plants, Labyrinthodont Amphibia, pseudomorphs of crystals of salt, rain pittings, and sun-cracks all point in the same direction. The occurrence of gypsum in the red marls affords additional proof. Neither crystals of chloride of sodium nor deposits of sulphate of lime could have been formed amid common mechanical sediments at the bottom of an open ocean. Only concentration by solar evaporation of inland waters could have produced this result.

In like manner the Magnesian limestone seems also to have been deposited, not in the sea, but in an inland salt lake, or in lakes. The land plants, the Labyrinthodont Lepidotosaurus Duffii, and the land reptiles Proterosaurus Speneri and P. Huxleyi, help as parts of the evidence; and instead of a great marine fauna like that of the Carboniferous limestone, containing many hundred species of Mollusca, corals, &c. &c., the whole British Permian aquatic fauna only embraces about 100 species, of which the molluscs are dwarfed in size compared with their Carboniferous congeners, when such there are. The luxuriant corals are gone (save one), and crinoids there are none. This poverty in number and size can be best compared to the restricted marine faunas of the Caspian and the Sea of Aral, or to that of the older and more extended area of inland drainage in the same area, in which the shells are partly fossil.

The composition of the rock also bears upon the point, being in the main composed of carbonate of lime and carbonate of magnesia in about equal proportions. No marine creature uses carbonate of magnesia wherewith to form its shell, and therefore its deposition must have been due to concentration of solutions caused by evaporation, while the carbonate of lime in the rock may have been partly produced by the life and death of molluscs. All these points seem to prove that these Permian formations were deposited, not in the sea, but in great inland salt lakes.

The New Red Sandstone Series, or Trias, succeeds the Permian strata. It has received the name of *Trias* from the fact that when fully developed, as in Germany, it consists of the three great divisions of *Keuper*, *Muschelkalk*, and *Bunter Sandstein*. Few old genera and no species pass thus far upwards. The majority of the genera of Brachiopoda disappear, and the whole grouping of the fossils now ceases to be Palæozoic, and assumes a character common to the Secondary rocks. The British section, with the exception of the Muschelkalk, is as follows:—

Keuper.	Red marl and thin bands of white sandstone with rock-salt White sandstone and red marl.
	(Muschelkalk absent in Britain.)
Bunter.	Soft red sandstone. Quartz conglomerate. Soft red sandstone.

These beds, with variations, occupy the undulating lands from Devonshire along the banks of the Severn, round the eastern borders of the Palæozoic rocks of Herefordshire and North Wales. From thence they stretch eastward to the Permian and Carboniferous rocks of Lancashire, North Staffordshire, and Derbyshire. They surround all the midland coal-fields and Permian beds between Shrewsbury, Coventry, and Derby, and everywhere unconformably overlying the Permian rocks stretch north in a long band from Nottingham to the river Tees. In its greatest development in England, the Bunter series is about 2000 feet thick. The Muschelkalk (absent in Britain) may be well seen, among other places, near Gotha, and at Eisenach in Thuringia. It is a grey shelly limestone, rich in Terebratulæ, Trigonias, Myas, Plagiostomas, Aviculas, Oysters, and Pectens. The genus Ceratites, closely allied to if not a true Ammonite, occurs here. Lamellibranchiate molluscs, some of new genera, abound as individuals, while Brachiopoda (excepting Terebratulæ) sink in the scale.

At Guttenstein and Werfen, in the Austrian Alps, there are strata at the base of the New Red Sandstone, which contain a rich and peculiar fauna—Ammonites, Belemnites, and other secondary forms being mixed with Orthoceratites, Goniatites, and other genera usually considered characteristic of Palæozoic times.

No fossils are known in the New Red or Bunter Sandstones of England, though a few are found in equivalent strata on the Continent.

In England, above the upper soft red sandstone are

beds of red, white, and brown sandstone, and red marl, often ripple-marked, and containing bones and footprints, chiefly of Labyrinthodont reptiles (footmarks and tooth of Labyrinthodon, fig. 19), together with a few plants, and a peculiar fish, Dipteronotus cyphus, found near Bromsgrove in Worcestershire. The largest impressions of footprints are 8 to 10 inches in length, and in front of each is a smaller one made by the forefoot. The rock-salt of England lies above these beds in the great marly plains of Lancashire, Cheshire, and Worcestershire. It lies at varying depths in interrupted lenticular beds, ranging from a few feet to about 120 feet in thickness. No fossils occur in it. The mass is usually of a reddish colour, due to the presence of ferruginous impurities. This rock-salt was deposited in supersaturated salt lakes during the Keuper period; and this could only have been done by evaporation due to solar heat acting on the waters of salt lakes which had no outflow, like the Great Salt Lake of Utah, for example, or the salt lakes of Central Asia. The red marl varies from 500 to 2000 feet in thickness, and contains a thin band of white sandstone, often with pseudomorphs of crystals of rock-salt, bearing a small bivalve crustacean, Estheria minuta, Pullastra arenicola, Hybodus Keuperi, footprints and bones of reptiles, and fucoidal marks. On the Continent, near Strasburg, about thirty species of plants are known in the Bunter beds, chiefly Ferns, Calamites, Cycads, and Coniferæ, and with them fish and Labyrinthodont amphibia and marine mollusca of the genera Trigonia, Mya, Mytilus, and Posidonia, so few in number, that in connection with the Labyrinthodonts, &c., they suggest the idea, not of an open ocean, but of a salt lake. In Scotland, at Lossiemouth, Keuper sandstones contain scutes and bones of a crocodile (Stagonolepis Robertsoni) and a land reptile (Telerpeton Elginense). In the United States numerous footprints, some said to be those of birds, and others Dinosaurian, occur in New Red sandstone, the largest impression of a single foot being 18 inches in length.

On the whole, the same kind of arguments already applied to the Permian strata may with increased force be used in relation to the New Red sandstone and marl of Britain, especially the occurrence of rock-salt and gypsum, and the red colour of the rocks. But in the Eastern Alps of the Tyrol, &c., the Trias is represented by a great thickness of highly fossiliferous marine strata.

The Rhætic Beds.—At the top of the Alpine Trias are some 2000 feet of marine strata, known as the *Rhætic series*. These are represented in Britain by the thin *Rhætic beds*, which seem to have been deposited in shallow seas and estuaries, or in lagoons or occasional salt lakes of small size, now and then separated from the sea by minor accidental changes in physical geography. Typical localities are Penarth, near Cardiff, and Aust Cliff on Severn. The fossils in these English beds are few, and the vertebrate forms occur in a 'bone-bed' (compare *Ludlow* series above), and include, among Reptiles, Plesiosaurus costatus, P. Hawkinsii, P. trigonus, and Ichthyosaurus platyodon, common both to the Rhætic beds and the base of the Lower Lias. The fish which were described by Sir P. Egerton are, among others, Acrodus minutus, several species of Ceratodus, Gyrolepis Alberti and Gyrolepis tenuistriatus, Hybodus plicatilis, Nemacanthus filifer and monilifer, Saurichthys apicalis and Dapedius politus (see the illustration). Rhætic fissure-deposits in the Carboniferous limestone of the Mendips have yielded the teeth of a small land-animal (Microlestes antiquus), possibly a mammal, but most likely a reptile. The most characteristic invertebrate fossils are the Lamellibranchs, Avicula contorta, Pecten Valoniensis, and Cardium Rhæticum.

All over England, wherever the base of the Lower Lias is well seen, the Rhætic beds, rarely more than 50 or 100 feet thick, are found to lie between the Lias and the New Red Marl. The 'White Lias' of Lyme-Regis is now classed with this formation. As a general rule they are seen to pass conformably and by easy gradations into each other, and they ought to be considered as true beds of passage between the red marl and the Liassic strata. They were indeed always classed with the Lias till separated from these strata by Dr. Wright; but there is no definite boundary line between them and the true New Red Marl.

The LIAS and OOLITE series succeed the New Red and Rhætic beds. On the Continent the strata from the base of the Lias to the Purbeck beds are termed *Jurassic*, so called because in a typical form they are largely developed in the range of the Jura. The Lias consists of the following subdivisions in England, in descending order:—

Upper Lias shale, or clay.
Marlstone.
Lower Lias shale, or clay and limestone.

The *Lower Lias*, clay and limestone, is about 900 feet thick, and consists of beds of blue clay (weathering brown) interstratified with beds of blue argillaceous limestone, largely quarried in Leicestershire, Warwickshire, &c., for hydraulic lime. The Lower Lias is well exposed in the coast section at Lyme-Regis. From thence, scarcely interrupted at the east end of the Mendip Hills, the Lower Lias strikes north to the junction of the Severn and Avon, and again north-east and north to the sea-coast of Yorkshire, east of the river Tees. Throughout this area it usually forms a flat or undulating country, lying much in pasture land. The strata dip gently to the east. Sometimes the limestones of the Lower Lias form a low escarpment generally facing west, and almost invariably the *Marlstone* or *Middle Lias* makes a similar and higher escarpment, the top of which is formed by a tough brown fossiliferous limestone generally of only a few feet in thickness, but nearly constant in its occurrence from Dorsetshire to Yorkshire.

From 10 to 50 feet above the Bone bed of the Rhætic strata there are certain thin bands in the Lias, named by the Rev. P. B. Brodie, who first described them, the 'insect limestones'. In these have been found numerous elytra and other remains of Beetles, Grasshoppers, Cicadas, Dragonflies, and other neuropterous insects. These are associated with a fresh-water shell of the genus Cyclas, and the shells of Cypris. These beds, therefore, indicate either fresh-water strata, or else the immediate proximity of land, from whence streams washed into the sea insects and fresh-water Crustacea and shells.

The remainder of the Lower Lias clay and limestone, as a whole, is rich in the remains of life. Among these are a few Ferns, Equisetaceæ, coniferous plants, Cycadeæ, and Characeæ. Corals are rare, and in Britain chiefly occur in the Isle of Skye. The Lias yields Pentacrinites and other Crinoids, Decapod crustaceans, Terebratulæ (T. numismalis, T. punctata, &c.), Rhynchonellæ, Waldheimiæ, Spiriferinæ, and other Brachiopoda, and numerous Lamellibranchiate molluscs, among the most characteristic of which are the well-known Gryphæa incurva (fig. 20), and Oysters; Lima gigantea and Pholadomya ambigua, various Cardiniæ, Avicula cygnipes (fig. 21), Pectens, &c. Cephalopoda of the genera Ammonites and Belemnites are especially numerous, together with Nautilus. Some of the

common Liassic forms are Ammonites obtusus (fig. 22), A. planorbis and raricostatus, Nautilus intermedius, and Belemnites acutus, B. elongatus, &c. These form a marked contrast to the Lituites, Clymenia, Orthoceratites, &c., of the Palæozoic formations. Of pentangular Crinoidea, Extracrinus Briareus is by no means rare. Fish are numerous of many genera and species, common among which are Æchmodus Leachii, Lepidotus fimbriatus, &c., Dapedius Colei, &c., and there appear in the Lower Lias a great number of remarkable reptiles, some of gigantic size, as the Ichthyosaurus or fish-lizard (I. communis, fig. 23), the Plesiosaurus (P. Dolichodeirus, fig. 24), and the Pterodactyle (Pterodactylus brevirostris), a carnivorous reptile with wings somewhat like those of a bat. (For general form of this last animal, see Plate III.)

The *Marlstone* series, or *Middle Lias*, which succeeds the Lower Lias clay, is generally a brown, ferruginous, soft, sandy rock, with hard nodular bands, and a brown limestone at the top. It is rich in many forms of Ammonite, Belemnite, Plagiostoma, Lima, Pinna, Pholadomya, Pecten, Modiola, Terebratula, and Rhynchonella, besides a very interesting 'star-fish bed', containing numerous specimens of brittle star-fishes (Ophioderma). Where the Lower Lias and Marlstone join, the strata generally graduate into each other, but through the central parts of England these passage-beds are rarely clearly exposed. In Yorkshire, however, on the sea-cliffs near Staithes, it is evident that there is no line of demarcation between them, and through about 15 feet of strata fossils common to both occur, one of the most conspicuous of which is Pecten æquivalvis.

The *Upper Lias clay* is generally poorly exposed, excepting on the coast of Yorkshire, where many great excavations have been made for the extraction of alum shale and the manufacture of alum. The well-known Whitby jet also comes from the Upper Lias. It is a stiff, infertile, dark-blue clay, with occasional layers of limestone containing many Belemnites, Ammonites (A. serpentinus, A. bifrons, &c.), and other shells, such as Leda ovum, Trigonia, &c. In Gloucestershire, where it is poorly developed, it sometimes graduates into the sands above, which have generally been classed with the Inferior Oolite beds, and which were shown by Dr. Wright of Cheltenham to contain many Marlstone and Upper Lias fossils. These sands are generally fine-grained, soft, and brown, with nodular bands and concretions containing Ammonites. At the top is a band of limestone several feet in thickness, rich in Belemnites, Ammonites, Nautili, and many Lamellibranchiate molluscs. The Ammonites of this series (A. bifrons, &c.) are decidedly Liassic. These are mixed with a certain number of shells which pass into the *Inferior Oolite*, thus linking the Liassic rocks directly to the Oolitic formation.

The predominant Liassic fossils are Cephalopods, especially Ammonites, by means of which it has been found possible to divide the entire series into about a dozen 'ammonite zones', each characterized by a special assemblage of fossils.

In Yorkshire, at the top of the Lower Lias and in the Marlstone, there are the well-known beds of ironstone so extensively used at Middlesbrough.

The OOLITIC SERIES comes next above the Lias, and consists of the various subdivisions of the LOWER, MIDDLE, and UPPER OOLITE (see table, p. 139).

The *Inferior Oolite*, the lowest member of the Lower Oolite, chiefly consists of beds of yellow limestone, of which the most typical section occurs at Leckhampton Hill, near Cheltenham. At the base those sands occur that form the passage-beds between the Upper Lias and the Inferior Oolite. They are well seen at Frocester, Midford, and Wotton-under-Edge. Much of the limestone is Oolitic, that is to say, it is formed of small concretionary bodies, like the roe of a fish, cemented together in a calcareous matrix. It has been suggested by Wethered and others that the grains have in some cases at least been formed round filaments of an alga (Girvanella) as a centre. At the base, near Cheltenham, these Oolite grains are as large as peas, and the rock is locally termed pea-grit. In Northamptonshire the lower beds are sandy and ferruginous, and have been worked for ironstone. The whole is fossiliferous, abounding in Lamellibranchiate molluscs, some of the most common being Lima pectiniformis, and other species; Pecten articulatus, &c., Ostrea gregaria, O. flabelloides, &c., Arca, Cardium, Pholadomya fidicula, &c., Isocardia, numerous Trigoniæ (T. costata), &c., Perna rugosa, &c., Modiola explanata and many others, Avicula, Gervillia, Inoceramus, and other genera. Among the Brachiopoda, Terebratula and Rhynchonella are exceedingly numerous, including T. perovalis, T. Phillipsii, T. fimbria, Rh. cynocephala, &c. Belemnites occur, 'zone' and other Ammonites, such as A. Sowerbyi, A. Murchisonii, A. concavus, &c.; also Nautili, such as N. polygonalis, N. excavatus, &c. Sea-urchins are found in great numbers, Acrosalenia, Lycettii, Cidaris Wrightii, Diadema depressum, Holectypus hemisphæricus, Echinobrissus clunicularis, Pygaster semisulcatus, and many other genera and species. A very fair number of genera and species of Gastropoda are known, including Pleurotomaria, Natica, Littorina, Patella, Fissurella, &c., and bones of large Saurians are occasionally found.

Plants are rare in the purely marine strata of Gloucestershire and the south of England, but fragments of coniferous trees are sometimes found, the most remarkable of which is a large cone, Araucarites hemisphæricus.

The Inferior Oolite yields much good building-stone, especially near Cheltenham, and it is occasionally burned for lime.

Above the Inferior Oolite limestone lies the *Fuller's-earth*, so originally named by William Smith because it contains in places beds of that substance. The formation consists of stiff blue clay, which varies in thickness from a few feet to 200 feet near Bath. In the middle, in Somersetshire, there is a thick band of limestone called the *Fuller's-earth rock*, and the whole formation is occasionally interstratified with thin bands of shelly limestone, rich in Terebratulas, Rhynchonellas, small Oysters, Limas, and other fossils. Gastropoda and Cephalopoda are comparatively rare. Many of the fossils are also found in the Inferior Oolite, but some are peculiar. Among the most common and characteristic are Goniomya angulifera, Ostrea acuminata, Terebratula globata, T. perovalis, and Rhynchonella concinna. Ostrea acuminata and Terebratula perovalis, in some of the clayey fields, occur in such quantities that they may be gathered by the hundred.

The *Great* or *Bath Oolite* succeeds, and consists of—

Great Oolite, covered by Forest marble, and passing downwards into Stonesfield slate, which forms its base.

The *Stonesfield Slate* consists of beds of shelly laminated and oolitic limestone, with ferns, Cyclopteris, Glossopteris, Pecopteris, &c.; Cycads, Bucklandia squamosa, Zamias (Palæozamia) of various species, and Coniferæ. Elytra of beetles and wings of insects (Libellula Westwoodii, &c.), and numerous

shells of the ordinary oolitic genera; saurian bones (Plesiosaurus), Crocodiles and Pterodactyles, Oysters, Terebratula, Rhynchonella, Lima, Pecten, Trigonia, Patella, Nerinæa, Belemnites, Ammonites, &c. The reptiles (see the plate) include Ichthyosaurus advena, Plesiosaurus erraticus, and crocodiles of the genus Teleosaurus, allied to the Gavial of the Ganges (T. brevidens and T. subulidens), together with a great carnivorous reptile, Megalosaurus Bucklandi, capable of walking on the land, and probably about 30 feet in length. A flying reptile, Rhamphorhynchus Bucklandi, allied to the Pterodactyle, is found in this sub-formation, which has long been especially celebrated as containing the remains of mammals, viz. the lower jaw-bones of species of small insectivorous marsupials, Amphitherium Broderipii, A. Prevostii, and Phascolotherium Bucklandi (jaw of P. Bucklandi, as shown in fig. 28), and Stereognathus Ooliticus.

The *Bath Oolite*, of which the *Forest marble* forms the upper part, is best developed near Bath, where it yields the celebrated stone of which that city is built, and the *Bradford clay* belongs to the same series. Its best beds are of cream-coloured limestone, so soft when first extracted from the quarry that it can be easily sawed into blocks, but hardening on exposure. Some of its fossils are also found in the Inferior Oolite and Fuller's-earth, and there is a general agreement in the genera. Corals occur in the Great Oolite, including more than 20 species, chiefly belonging to the genera Stylina, Isastrea, Thamnastrea, &c., and Brachiopoda of the usual genera Rhynchonella (Rh. concinna, &c.) and Terebratula (T. digona, T. obovata, &c.), besides great numbers of Lamellibranchiata, the most numerous of which belong to the genera Ostrea (Sowerbii, &c.), Pecten (vagans, &c.), Gervillia (monotis, &c.), Lima (cardiiformis, &c.), Mytilus (imbricatus, &c.), Trigonia (impressa, &c.), Cardium and Pachyrisma, Astarte (rotunda, &c.), Ceromya (concentrica, &c.), Pholadomya (socialis, &c.), Cyprina, Pecten, Lima, and many others. Near Minchinhampton it is rich in Gastropoda, among the most common of which are many of the genera Patella, Pleurotomaria, Trochotoma, Purpuroidea (P. Morrisii, see in plate, fig. 29), Natica, Chemnitzia, Nerinea, Alaria, Cerithella, Cylindrites, Turbo, and many others. Ammonites and Belemnites are rare at Minchinhampton, but farther south Gastropoda decline, and Cephalopoda are more numerous. Echinodermata of the genera Acrosalenia, Clypeus, Echinobrissus, and others are not uncommon, and pentacrinite joints rarely occur. Fishes' teeth, Hybodus, Pycnodus, and Strophodus, and scales of Lepidosteus are sometimes found, and reptiles of the genera Teleosaurus and Megalosaurus, together with the gigantic Cetiosaurus (or whale-lizard), a dinosaur of about 50 feet in length, and most likely amphibious.

The *Forest marble* forms the topmost beds of the Great Oolite formation, and is a shelly limestone, with much false-bedding, very similar in structure to the Stonesfield slate. Its beds are full of Oysters, stems of Pentacrinites, fragments of Echinodermata, Pectens, Aviculæ, Terebratulæ, &c. In it occurs the *Bradford Clay*, in which is found the beautiful Crinoid, Apiocrinites rotundus, and also Terebratula digona (fig. 30), Oysters, &c.

The *Cornbrash* is a limestone of small thickness, the characteristic shells in which are Avicula echinata, Ostrea gregaria, and many Terebratulæ, Rhynchonellæ, claws of crabs, fragments of echini, &c. This limestone is exceedingly constant throughout England, extending almost without interruption from the south of England into Yorkshire.

Between Gloucestershire and the Yorkshire cliffs these Oolitic strata undergo great changes. Thus in North Gloucestershire and Northamptonshire the Fuller's-earth entirely disappears, and the Inferior Oolite lies directly on the Bath Oolite. The same is the case with the Inferior Oolite sand, or Upper Lias sand as it is sometimes called. For a space in Northamptonshire the Inferior Oolite becomes sandy and ferruginous, with lenticular bands of limestone, and strata containing fresh-water shells of the genus Cyrena; and by and by the limestone reappears full of sea-shells above these sands, overlaid by an upper estuarine or fresh-water clay full of plants, and overlaid by the Great Oolite to which it belongs. Farther north, in Yorkshire, the Great Oolite is altogether absent, and the Inferior Oolite lying above the Upper Lias consists chiefly of sandstones, shales, and ironstones, with very little limestone, and thin beds of coal rarely workable, which are often underlain by beds of clay, with roots strongly recalling to the memory the underclays of the Coal-measures. The shells are partly marine and partly fresh-water species (Unio) in different bands, and the beds of coal were often evidently formed of the remains of plants that grew on terrestrial soils in the position in which we now find them. These plants consist of ferns (Cyclopteris, Pecopteris, &c.), Cycadeæ, Equisetums, &c., and Araucarian-like Coniferæ, &c. Altogether it is evident that during this part of the Oolitic epoch, while in the south of England the strata were exclusively marine, in the middle and north they were to a great extent estuarine, freshwater, and terrestrial.

The MIDDLE OOLITE consists of the

Upper Calcareous Grit
Coral Rag.
Lower Calcareous Grit.
Oxford Clay
Kellaways Rock.

The *Oxford Clay* is a dark-blue clay, about 600 feet thick where best developed, running in a long band of varying width from the coast of Dorsetshire to the Derwent in Yorkshire. Near its base is an occasional thin band of calcareous sandstone, called *Kellaways rock* by Smith, and which, as it sometimes has a blue clay between it and the Cornbrash, may be considered to be a member of the Oxford Clay. It occurs at intervals along many parts of the base of the Oxford Clay, and is well seen in Filey Bay in Yorkshire. It contains many Gryphæas and Ammonites, one of which, A. Calloviensis, has heretofore been found in no other stratum. Altogether more than 150 species are known in the Kellaways rock, including several Ammonites and another Cephalopod, Ancyloceras Calloviense, besides Nautili (N. hexagonus), &c. Brachiopoda and Lamellibranchiata, and other kinds of life of the Oolitic epoch, are common, and a considerable number of the species are also found in the Lower Oolites. The *Oxford Clay* also contains many Belemnites (B. abbreviatus, fig. 31), and many Ammonites and other shells, among which Ammonites Jason, Ostrea Marshii, and Gryphæa dilatata are characteristic of this formation. Trigonia costata (fig. 26), an Inferior Oolite species, passes upward thus far. The general assemblage, generically and partly in species, strongly resembles that of the Lower Oolite formations, but the life is not so numerous. Fishes, Hybodus, Lepidotus, and Pycnodus, are found, and Reptilia of the genera Dakosaurus, Ichthyosaurus (I. dilatatus and thyreospondylus), Megalosaurus Bucklandi, Pleiosaurus gamma and grandis, species of Plesiosaurus, (P. Oxoniensis, &c.), Rhamphorhynchus Bucklandi, Steneosaurus, and Streptospondylus Cuvieri.

The *Coral Rag* is a rubbly limestone, trending,

shells of the ordinary oolitic genera; saurian bones (Plesiosaurus), Crocodiles and Pterodactyles, Oysters, Terebratula, Rhynchonella, Lima, Pecten, Trigonia, Patella, Nerinæa, Belemnites, Ammonites, &c. The reptiles (see the plate) include Ichthyosaurus advena, Plesiosaurus erraticus, and crocodiles of the genus Teleosaurus, allied to the Gavial of the Ganges (T. brevidens and T. subulidens), together with a great carnivorous reptile, Megalosaurus Bucklandi, capable of walking on the land, and probably about 30 feet in length. A flying reptile, Rhamphorhynchus Bucklandi, allied to the Pterodactyle, is found in this sub-formation, which has long been especially celebrated as containing the remains of mammals, viz. the lower jaw-bones of species of small insectivorous marsupials, Amphitherium Broderipii, A. Prevostii, and Phascolotherium Bucklandi (jaw of P. Bucklandi, as shown in fig. 28), and Stereognathus Ooliticus.

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The *Coral Rag* is a rubbly limestone, trending,

with occasional interruptions, from Somersetshire to Yorkshire. It is associated in places with sandy strata known as the *Calcareous grits*, and is often almost entirely composed of broken shells and Echini, Cidaris Smithii, Hemicidaris intermedia, Pygaster umbrella, Pygurus costatus, &c., and corals of the genera Isastræa, Thecosmilia, Protoseris, &c., Ammonites, a few Gasteropoda, and various genera of bivalves.

The UPPER OOLITE consists of

Portland limestone and sand.
Kimmeridge clay.

The *Kimmeridge Clay* is well exposed in Kimmeridge Bay, on the Dorsetshire coast, whence its name. Occasionally interrupted by overlaps, it runs from thence north into Yorkshire. In places it is 500 or 600 feet thick, and consists of a stiff blue, and sometimes black, clay or shale, with septaria. It is frequently bituminous, and has been used for the manufacture of mineral pitch. A shell peculiarly characteristic of it is a large oyster, Ostrea deltoidea. Shells of the genera Rhynchonella (Rh. inconstans) and Terebratula, Discina (D. Humphresiana, &c.), Lingula ovalis, Pinna, Astarte, Pecten, Trigonia (T. incurva), and other bivalves, and a few Ammonites (A. biplex, &c.) and Belemnites, are also common, the Belemnites sometimes almost paving the ledges of the sea-shore in Kimmeridge Bay. Fishes of the Oolitic genera already named, with others, are found, and many remains of reptiles, among others a turtle, Crocodiles of the genera Goniopholis, Teleosaurus and Steneosaurus, species of Ichthyosaurus, Plesiosaurus, and Pleiosaurus, some of the last of great size. Cetiosaurus longus and Megalosaurus Bucklandi also occur. Fragments of wood are not uncommon.

The *Portland Limestone and Sand* lie above the *Kimmeridge Clay*. The best sections of these rocks occur in the Isle of Portland. The sand which forms the base of the formation is there 150 feet thick, and the limestone about 70. Of this, about 20 feet forms marketable stone in three horizons, from the best part of which the celebrated Portland stone is derived, used in many public buildings, of which St. Paul's may be cited as an example. The limestone, like those of all the other Oolite formations, is cream-coloured, and generally fossiliferous. Among the most common forms found in it are Trigonia gibbosa and T. incurva, Pecten lamellosus, Ostrea expansa, Cardium dissimile, Terebra Portlandica, and various Ammonites, some of them of large size. The lowest beds are full of layers of flint and chert. The sand is fossiliferous, containing Oysters, Cardiums, &c. The Portland stone also occurs at the south end of the Isle of Purbeck, in the Vale of Tisbury, Wiltshire, at Swindon, and in the Vale of Aylesbury.

In Scotland, patches of Jurassic rocks occur in the inner Hebrides (Skye, Mull, &c.) and on the shores of the Moray Firth.

Oolitic rocks, known by the name of *Jurassic*, almost identical with those of Britain, occur largely in France. The mountain range of the Jura, dividing France and Switzerland, is chiefly formed of Liassic and Oolitic rocks, highly disturbed. A large part of the still more violently disturbed rocks of the Swiss Alps belong to the same formations. The shales are there often highly cleaved, the limestones crystalline, and the beds are sometimes metamorphosed into gneiss. From thence they range interruptedly northwards and eastwards, covering a large part of the plains of European Russia, and extending along the Himalaya.

The general nature of the fossil contents of the Liassic and Oolitic rocks may be briefly summed up as follows:—From the base of the Lias to the top of the Portland Oolite, the general facies of life is the same. In the British rocks many genera and species of ferns occur, almost all of which are found in the Inferior Oolite of Yorkshire. The same is the case with most of the other plants, chiefly Equisetaceæ, coniferous plants, Cycadeæ, and Charas. Comparatively few Corals have yet been found in the Lias (Isastræa, Thecosmilia, Montlivaltia, &c.). The remainder, of many genera and species, occur chiefly in the Lower Oolites, and partly in the Coral Rag. Of Crinoidea, the most common are Pentacrinites in the Lias and Inferior Oolite, and Apiocrinus in Bradford clay. Other Echinodermata (sea-urchins) are very numerous, chiefly in the Lower Oolite, and a few Star-fish and Ophiuridæ occur, chiefly in the Marlstone of the Lias. Crustacea are comparatively scarce. Species of insects have been described, partly from the Lower Lias and Stonesfield Slate. By far the most common Brachiopoda, both specifically and as individuals, are Rhynchonellæ and Terebratulæ. The chief species, numerically, of the Lamellibranchiata belong to the genera Avicula, Gervillia, Lima, Ostrea, Pecten, Astarte, Cardium, Modiola, Myacites, Pholadomya, Trigonia. There are more than 300 species of Gastropoda, a large proportion of which are from the Inferior and Great Oolites. The most common are Trochus, Turbo, Pleurotomaria, Patella, Alaria, Chemnitzia, and Nerinea. A remarkable feature of the whole series is the vast development of Cephalopoda, especially of the genera Belemnites, Nautilus, Ammonites, and Ancyloceras. The number of genera and species of fishes already known is very large, more than 200, chiefly in the Lias. The genera and species of reptiles already noticed are so numerous that it has, not very philosophically, been sometimes called 'the age of reptiles'.

Viewed as a whole, the Liassic and Oolitic strata seem to have been deposited in warm seas round groups of islands formed of the older Palæozoic rocks of Europe, of which the Highlands of Scotland, Cumberland, and Wales formed parts, and from which rivers flowed, at the mouths of which the estuarine and fresh-water deposits of the north of England and Scotland were accumulated, and this land, growing by upheaval, at length gave birth to the great river that deposited the Purbeck and Wealden strata.

With some geologists it has been customary to consider the Purbeck strata as forming the topmost subdivision of the Oolites, and the Wealden strata as belonging to the Cretaceous series; but as in reality the interval between the marked marine series of the Oolitic and Cretaceous epochs are, in Britain, bridged over by the terrestrial and fluviatile episode of the Purbeck and Wealden beds, it is more convenient, and in the chief part of the British area more philosophical, to treat of these formations as marking one great epoch.

The Purbeck and Wealden beds are as follows:—

Purbeck and Wealden Series.
- Weald clay.
- Hastings sands and clays.
- Purbeck limestones, marls, and clays.

The PURBECK BEDS succeed the Portland stone, and lithologically, near Tisbury, they pass gently into each other. The *Purbeck beds* are, however, chiefly fresh-water strata, and the transition from the uppermost marine beds of the Portland to the lowest fresh-water strata of the Purbeck series is sudden. These are about 8 feet thick, and contain fresh-water remains of the genera Cyclas, Valvata, Limnæa, and Cypris.

Near the base of the Purbeck rocks, in Portland

and Purbeck, lie three beds, known by the quarrymen as the 'dirt beds', which, from their colour and earthy character, were clearly ancient soils. They are full of the silicified stems and stools of coniferous trees, the former procumbent and the latter with roots attached, frequently standing in the soil in the position in which they grew. Plants (Cycadites microphyllus, &c.) allied to the modern Cycas and Zamia are also found in them. In the Isle of Purbeck the whole of the Purbeck strata are about 360 feet thick in their largest development. They consist chiefly of limestones and marls, principally of fresh-water origin, with interstratifications of marine, brackish water, and terrestrial bands. According to the sections of the government geological survey by Bristow, there are indications of four terrestrial surfaces, eleven sets of fresh-water beds, four brackish water, and three marine bands, the last containing Pectens, Modiolas, Aviculas, and Thraciæ. One of these, the 'cinder-bed' of the quarrymen, is about 12 feet thick, and is composed almost exclusively of oysters (Ostrea distorta). Along with these, sparingly, was found a Perna and an Oolitic genus of Hemicidaris (H. Purbeckensis). As a mass, the Purbeck rocks were divided by Professor E. Forbes into three divisions, each especially distinguished by distinct species of Cypris. In the Lower Purbeck are found Cypris punctata and C. Purbeckensis; in the Middle, C. granulata, C. fasciculata, and C. striatopunctata; and in the Upper, C. tuberculata, C. leguminella, and C. gibbosa. The fresh-water shells of the various beds are chiefly species of Paludina, Limnæa, Planorbis, Physa (P. Bristovii, see plate, fig. 32), Valvata, Unio (U. compressus, fig. 33), and Cyclas (C. parva, fig. 34). The celebrated Purbeck marble, so largely used in the palmy days of Gothic architecture for the decoration of churches, lies near the top of the Upper Purbeck. It is chiefly formed of remains of the delicate fresh-water univalve, Paludina fluviorum. Species of fish have been found in the Purbeck strata; among these, Lepidotus minor, Pholidophorus ornatus, Microdon radiatus, Ophiopsis breviceps, Hybodus, and Asteracanthus, are the most characteristic.

Numerous wings, elytra, and other fragments of insects (Coleoptera, Orthoptera, Hemiptera, Neuroptera, and Diptera) occur in thin bands in the Purbeck limestones. Some of these (dragon-flies, &c.) are such as would live on the marshy banks of rivers. Among the reptiles are Crocodilia—viz. Goniopholis crassidens, and Macrorhynchus; Lacertilia; fresh-water Tortoises, and Turtles—viz. Pleurosternon concinnum, P. emarginatum, P. ovatum, &c.

In 1854 portions of the jaw-bone of a small marsupial insectivorous mammal, Spalacotherium tricuspidens, were found by Mr. Brodie at the base of the Middle Purbeck. At the close of 1856 Mr. Beckles commenced a further search in the same bed, which was rewarded by the discovery of about twenty species of mammals. The most important genera are Triconodon and Spalacotherium, both marsupial, and the still more primitive types Plagiaulax, Bolodon, Allodon, and Ctenacodon, which came nearer the monotremes. This Mesozoic mammalian life was 'low, insignificant in size and power, adapted for insect food, for preying upon small lizards, or on the smaller and weaker members of their own low mammalian grade' (Owen). This mammalian fauna, as far as it goes, at once suggests comparison with the existing fauna of Australia, and the flora of the time has like analogies in part.

In the Wealden area the Ashburnham beds, which consist of bands of fresh-water limestone and clays, are the equivalents of the Purbeck strata, and by an experimental boring there has been proved to lie beneath them about 30 feet of gypsum, a mineral much more sparingly developed in the lower strata of the Isle of Purbeck. These gypsum beds were probably deposited in a lake formed in the delta of the river. Beneath these lie the Portland beds, &c.

The *Hastings sand* and *Weald clay* are almost exclusively fresh-water beds, and must be considered as a continuation of the deposits formed at the mouth of the great river, which commenced with the deposition of the Purbeck limestones and shales. The name *Wealden* applies to the whole group above the Purbeck rocks, and the term originated from the circumstance that these fluviatile beds are largely developed in the Weald of Kent and Sussex. Their true character was first discovered by Dr. Mantell. As a whole, the Hastings sands form the lower portion, though sometimes by changes of character the sands and clays of that series pass into each other. In the various beds are found ferns of the genera Alethopteris, Otopteris, and Sphenopteris, the latter sometimes standing erect, as if in the position of growth. Coniferous wood and Cycadeous plants also occur. With rare exceptions, the shells are of fresh-water genera, viz. ten species of Unio, five species of Cyrena, besides Cyclas, Melanopsis, Melania, and Paludina (P. Sussexiensis, see plate, fig. 35), together with Cypris (C. Valdensis, fig. 36), and these are sparingly interstratified with beds containing Oysters, Corbula, and Mytilus. Several remarkable reptiles occur in the Weald, of the order Dinosauria, belonging to the genera Hylæosaurus, Megalosaurus, Iguanodon; Plesiosaurus, and Pterodactylus, together with nine species of Crocodilia, of seven genera. The Iguanodon was first described by Dr. Mantell as a herbivorous reptile of gigantic size. Its teeth were serrated like those of the modern Iguana, but, unlike them, it masticated its food. Various Elasmobranch and Ganoid fish also occur in the Wealden. The strata composing the Hastings sand series are about 700 feet thick, and the Weald clay, where thickest, is of equal thickness.

In Yorkshire there is a deposit long known as the Speeton clay, and probably equivalent to the strata ranging from Upper Kimmeridge and Lower Gault inclusive. The Wealden beds proper may therefore be considered to be fresh-water representatives of the middle and lower Neocomian series.

The true marine series of the CRETACEOUS EPOCH in England is as follows:—

Upper.	Chalk with flints. Chalk without flints, marl, and Chloritic marl. Upper Greensand. Gault.
Lower.	Lower Greensand. Atherfield clay.

The *Atherfield Clay* takes its name from Atherfield on the south-west coast of the Isle of Wight, where it is well seen overlying the Weald clay and overlaid by the *Lower Greensand*. Its lowest strata form a kind of passage from the fresh-water strata of the Weald into the overlying marine beds, both in the Isle of Wight and in the Wealden district of Kent and Sussex, for at Atherfield there seems to have been a depression of the fresh-water area and an influx of the sea, accompanied by the appearance of Cerithium carbonarium. Many other shells are scattered through the clay, including the well-known Perna Mulleti (shown in plate, fig. 38), Trigonia caudata, Gervillia aviculoides, Arcas, Pectens, Oysters, Rostellaria Parkinsoni, an urchin Hemicardium Austeni, &c. &c. Above this horizon are the strata usually called *Lower Greensand*, beginning with a bed of sandstone containing Gryphæa sinuata and many other shells, succeeded by 29 feet of clay, commonly called the 'lobster bed', from the presence of Meyeria

Vectensis, formerly called Astacus, together with Ammonites Deshayesii, &c., overlaid by nodular bands with Gervillia aviculoides, &c., above which clay is repeated, with the same Meyeria. Above this, sands and clays alternate to the top of the series with many fossils, among which may be mentioned as characteristic, Terebratula sella, T. Gibbsii, T. biplicata, Limas, Gryphæas, Gervillia solenoides, Ammonites, Nautilus, and other remarkable Cephalopoda of the genera Crioceras, Scaphites, and Hamites. The whole of these strata overlying the Wealden beds occur in magnificent sections along the southern cliffs of the Isle of Wight, dipping northerly under the Gault, Upper Greensand, and Chalk, which in a high ridge stretches across the island from Culver Cliff to Alum Bay. Overlaid by the Gault, and reposing on the Weald clay, the Lower Greensand also sweeps round the whole Wealden area from Sandgate to Guildford and Haslemere, and from thence to the coast north of Beachy Head. Between Guildford and Haslemere it forms high scarped terraces. The sands are sometimes quite soft, with intercalated hard bands, and they are frequently ferruginous. A good building-stone, very fossiliferous, sometimes an impure limestone, called the Kentish rag, lies in the lower part of the formation on the north side of the Weald at Maidstone. It rests on the Atherfield Clay with marine shells. The general grouping of the fossils in all this area corresponds with that of the Isle of Wight. In Dorsetshire and part of Somersetshire, at the south end of the western escarpments of the Cretaceous rocks, the Lower Greensand is absent, and the Upper Greensand rests directly on the Lias and New Red series. Farther north, much attenuated, the Lower Greensand appears in patches cropping out between Devizes and Farringdon, and ranging into Cambridgeshire and Lincolnshire. The general characters of the whole formation are white, yellow, ferruginous, and gray and green sands. Fossil coniferous wood is of frequent occurrence in it.

The general character of the fossils of the series are as follows:—Echinoderms of the genera Salenia (S. punctata, see the plate, fig. 37), Cardiaster, Diadema, Hemipneustes, Discoidea, and Echinus, together with Pentacrinites, are found in it. Terebratulæ and Rhynchonellæ are of frequent occurrence, with a few other Brachiopoda. Among the Lamellibranchiate molluscs are numerous Limas, Gervillias, Oysters, Pectens, and Pinnas, together with shells of the genera Cardium, Venus, Trigonia, Myacites, Nucula, and Perna. Gastropoda are not generally numerous. Cephalopoda of remarkable forms are characteristic; for, in addition to several species of Ammonites, Nautili, and Belemnites, there are Crioceras, and Ancyloceras, like Ammonites half unrolled (Crioceras Bowerbankii, Ancyloceras gigas, A. grande, A. Hilesii), and Turrilites. Fishes and reptiles are scarce.

Out of about 300 Lower Greensand species, 18 or 20 per cent pass into the *Upper Cretaceous* series. Partly for palæontological considerations, and partly because the Gault seems sometimes to lie, as it were, unconformably on the eroded surface of the sand, the dissimilarity in the grouping of fossils is so great that it has been considered advisable to draw a marked line between the two groups. On the Continent, rocks equivalent to our Lower Greensand are largely developed near Neuchâtel (*Neocomium*), whence these and other associated strata are termed *Neocomian*.

The *Gault*, which forms the base of the *Upper Cretaceous* series, is a stiff blue clay about 300 feet thick in its thickest development. It appears in the Isle of Wight, ranges round the escarpment of the Weald, and in the centre of England, from the neighbourhood of Devizes to the Wash in Norfolk, the Gault occasionally overlaps the Lower Greensand in an unconformable manner. Many Foraminifera have been found in it, and a few Corals, Cyclocyathus Fittoni, Trochosmilia sulcata, and Caryophyllia Bowerbankii. Its sea-urchins are of the genera Cidaris, Hemiaster, and Diadema. It contains many Crustaceans, such as Pollicipes rigidus, Necrocarcinus Bechii, Palæocorystes Stokesii, &c. Among the Brachiopoda and Lamellibranchiate molluscs the following are characteristic:—Terebratula biplicata, Rhynchonella sulcata, Oysters, Pectens, Plicatula pectinoides, Pinna tetragona, &c.; Gervillia solenoides, Inoceramus concentricus, &c.; Lima parallela, Cucullæa, Arca, Nucula pectinata, &c. It also yields Gastropoda of the genera Dentalium, Solarium, Scalaria, Natica, Pleurotomaria Gibbsii, Rostellaria carinata, &c., and many Cephalopoda, such as Belemnites minimus, &c.; Nautilus inequalis, &c.; Ammonites splendens, A. dentatus, A. interruptus, A. lautus, &c. &c.; Crioceras Duvalli C. Puzosianus, Ancyloceras Hamites attenuatus; H. rotundus (Pl. III., fig. 39), &c. The Red Chalk at the base of the Chalk of Yorkshire is considered to be equivalent in age to the Gault and Upper Greensand.

In general lithological characters the *Upper Greensand* in places somewhat resembles the Lower Greensand. In the Wealden, however, and on the north-west and west escarpment of the Chalk north of Wantage, it passes into a white siliceous soft stone, a white clayey mud, and finally into actual chalk. In part of the Wealden area west of Folkstone it is very feebly represented and difficult to separate from the Gault, there being a lithological passage from one to the other. In Wiltshire the Upper Greensand is about 200 feet thick. Its topmost beds, near Dorchester, are cherty. It spreads westward in outliers beyond the river Exe in Devonshire, resting directly on the New Red Sandstone, and an outlier lies on the Carboniferous rocks near Bideford Bay on the north of Devonshire. During the deposition of the Upper Greensand in England, the older rocks were undergoing slow depression, and it gradually overlapped the Lower Cretaceous strata, then the Oolites, Lias, and New Red Sandstone, till it intruded directly on the Palæozoic rocks of Devonshire. It is often fossiliferous, containing Cycads and Coniferous trees; Sponges (Siphonia pyriformis, S. lobata); a few Foraminifera, Corals, Trochosmilia tuberosa, Micrabacia coronata, many genera of Echinoidea, the chief of which belong to the genera Cidaris, Cardiaster, Echinus, Diadema, Salenia, &c. Brachiopoda are common, chiefly Terebratulæ and Rhynchonellæ (T. biplicata, Rh. latissima, &c.). In Lamellibranchiate molluscs it is even richer than the Lower Greensand, abounding especially in species of the genera Inoceramus, Gryphea (lævigata), Lima, Pecten, Astarte, Trigonia, Cucullæa, Cyprina, and Cytherea. It is also rich in Gastropoda, such as Turritella, Pleurotomaria, Natica (N. Gentii), &c., and yields many species of Ammonites, Nautili, Hamites, Baculites, Scaphites, and Belemnites. Crustacea are found. Hoploparia longimana, Necrocarcinus Bechii, &c.

The *Chloritic marl* indicates a passage from the Upper Greensand into the Chalk. It consists of a chalky base specked with green grains, and varies from a few inches to a few feet in thickness. It is highly fossiliferous, abounding in Ammonites, Nautili (N. lævigata), and a small Scaphite (S. æqualis), besides Oysters, Trigoniæ, Urchins (Holaster, &c.), and many other shells.

The Chalk, from its familiar characters and uniformity of structure, is the most easily recognizable of all the British formations. From west to east it stretches from the neighbourhood of Beaminster.

in Dorsetshire, to Beachy Head and the North Foreland, and from thence north to Speeton, in Yorkshire. Its area in Europe and Asia is immense. It consists of a soft white limestone, generally much jointed, and but for the lines of flints, the bedding would often be scarcely distinguishable. On minute examination with the microscope, much of it is found to consist of the shells of Foraminifera, Diatomaceæ, spicules, and other remains of Sponges, Polyzoa, and shells, highly comminuted. Somewhat similar deposits are now forming in the open Atlantic at great depths, chiefly of Foraminifera of the genus Globigerina, Polycystina and Diatomaceæ, and spicules of Sponges. In the Pacific, also, from Java to the Low Archipelago, over an area of about 4000 miles in length, all the deep-sea deposits are of fine white calcareous mud, like unconsolidated chalk. In its thickest development in England the Chalk is about 1200 feet thick (in Dorsetshire, Hampshire, &c.). The Lower Chalk usually contains no flints and is somewhat marly at the base, while the Upper Chalk is interstratified with many beds of interrupted flints. These are of irregular form, and lie in layers in the lines of bedding. A great proportion of them are silicified Sponges, which often inclose other organic bodies such as shells, fragments of Belemnites, &c.; others of large size, called Paramoudras, stand vertically across the beds. These closely resemble, in general form, the large cup-shaped sponges of the Indian Ocean (Rhaphidophora, or Neptune's cup). As a whole, the Chalk dips gently from its western escarpment to the east and south, underlying the Tertiary strata of the Hampshire and London basins, and reappearing with precisely the same characters on the coast of France. In the north of Ireland, between Belfast and the Giant's Causeway, there are patches of very hard Chalk on the coast, overlaid by columnar basalt of Eocene age. The great superincumbent pressure of these masses of igneous rocks has hardened the chalk, and therefore they have not, as is usually supposed, been altered by the heat of overflowing lavas, except possibly for an inch or two at the immediate point of junction. Traces of Chalk and Upper Greensand occur at Bogingarry, &c., in Aberdeenshire. These consist partly of chalk flints, partly of sandstone possibly in place, and are sufficient to show that Cretaceous rocks which have been removed by denudation probably once spread over that country. Cretaceous strata also occur in the Island of Mull beneath the Eocene basalts.

About half the genera and a considerable number of Chalk species are identical with those of the Gault and Upper Greensand, but it contains a far greater number (nearly 800) most of which are peculiar to itself. Plants are few. A great many Sponges have been described, chiefly from flints. Among the most numerous are species belonging to the genera Plocoscyphia, Ventriculites, Dendrospongia, and Siphonia. A large number of genera and species of Foraminifera are also described, among which Globigerina bulloides, Dentalina gracilis, and Rotalina ornata are common. A number of species of Corals are known, several of which belong to the genus Parasmilia (centralis), Trochosmilia laxa, &c. Echinodermata are very numerous, among others including the genera Ananchytes, Cardiaster, Cidaris, Cyphosoma, Diadema, Echinopsis, Galerites, and Echinobrissus (G. Albogalerus and E. dimidiatus are shown, figs. 40 and 41), Holaster, Micraster, and Salenia, &c. Among its star-fish are comprised the genera Arthraster, Goniaster (G. Coombii, fig. 42), and Oreaster. Of these, Goniaster is exceedingly characteristic. In addition it has yielded an Ophiura and several Crinoids, Bourgueticrinus ellipticus, Marsupites Milleri, &c. On the shells, &c., found in the Chalk, are frequent Serpulæ. It also yields Cirripeds and a few Crustaceans, Enoploclytia Dixoni, &c. Polyzoa are numerous, of many species. Like other members of the Cretaceous rocks, its Brachiopoda generically resemble those of the Oolites, including Rhynchonellæ (R. octoplicata, fig. 43), Terebratulina lyra, and Terebratulæ (T. biplicata, &c.). The Lamellibranchiate molluscs of the Chalk are in some cases specifically identical with those of the Gault and Upper Greensand; and generically they bear the strongest resemblance, consisting, among others, of many species of Inoceramus, Lima, Pecten, Oyster, Spondylus, Radiolites, Trigonia, &c. Being a deep-sea deposit, it is poor in Gastropoda, but rich in Cephalopoda, especially in Nautili (N. elegans), &c., Ammonites (A. Rothomagensis), &c., and Turrilites (T. costatus, fig. 44), besides Baculites, Hamites simplex, Scaphites (S. æqualis, fig. 45), and Belemnites.

Numerically as individually, though still very characteristic, Cephalopoda are less numerous in the Cretaceous than in the Oolitic and Liassic strata, though the latter contain fewer genera. More than 80 species of fish are known in the Chalk, including not only Elasmobranchs and Ganoids, but also ordinary bony fishes (Teleostei). Many of the Elasmobranchs are Cestraciont fish, many species being of the genus Ptychodus. A number of reptiles are known, some of which are allied to the Crocodilia, Acanthopholis horridus, and Leiodon anceps (Dinosaurs); the great Mosasaurus; Plesiosaurus and Ichthyosaurus; the Pterodactyles, one of them of great size; several Turtles, Chelone Benstedi, &c., and various other Reptilian genera. The Cretaceous rocks of the western territories of North America have yielded numerous remains of an extraordinarily rich reptilian fauna, including members of marine and terrestrial orders peculiar to the Mesozoic. These strata also contain remarkable toothed birds. The largest of these (6 feet high), Hesperornis, was flightless. Ichthyornis was the size of a pigeon. Various small mammals of low type are found in the same rocks. Beyond England the Chalk stretches through France, northward into Sweden, and eastward into Asia. In the north of Europe, in texture it is generally uniform over large areas, but in the Alps, where it has been subject to great disturbance and pressure, the equivalents of the Chalk assume the form of a hard blue limestone; and in the south of Europe and Asia it is a cream-coloured limestone.

The lithological character of the Chalk, formed almost entirely of calcareous organic matter, and, like the bottom of the deep and open Atlantic, consisting largely of microscopic Foraminifera, indicates that it was a deep-ocean deposit. It may therefore be considered certain that during the deposition of this white calcareous mud the old land through which the Wealden river flowed was undergoing steady submergence, till probably only the tops of the mountains of what is now Wales and the north of England stood above the sea, or it may be that the whole area sunk beneath the water. It may even have been the case that the same took place with the mountains of Scotland and Ireland formed of Palæozoic rocks, and with those besides of much of what is now the Continent of Europe.

During a late part of this progressive submergence, in the neighbourhood of Aix-la-Chapelle there seems to have been a gulf occasionally invaded by the Cretaceous sea, in which white sands of Upper Cretaceous age were deposited, and in these

land-plants are found of more than 200 species, many of which are ferns which, when buried, were in fructification, and other Cryptogamia. Conifers are abundant, similar to the living Sequoia, Araucarias, and Screw-pines; Oaks, Figs, Walnuts, and Myrtles; together with perhaps 70 species of Proteaceæ allied to those now in Australia, and some of which belong to the living genera Dryandra, Grevillia, Hakea, Banksia, Persoonia. These were described by Dr. Debey; and as far as known, the general assemblage is of a mixed character, partly approaching the later floras of a Tertiary and recent type. A luxurious flora of Tertiary aspect is represented by fossils from the Cretaceous of North America and Greenland.

At Maestricht on the Meuse, and at Faxoe in the isle of Seeland, Denmark, there are certain chalky strata of later date than the ordinary Chalk of England, and older than the Eocene strata. A few of the fossils of both places are Chalk species, but most of them are distinct. At Faxoe many of the univalves belong to genera common in the Eocene rocks. On the whole these rocks must be considered as more closely connected with the Chalk than with the Eocene rocks. In parts of France and Belgium a set of rocks overlying the Chalk also show intermediate characters between those of the Cretaceous and Eocene strata. They contain no Ammonites, Baculites, Turrilites, or other characteristic Cretaceous Cephalopoda; but a few species of shells are common to the Chalk, and others pass rarely into the Eocene rocks. As a whole, though peculiar, they are more nearly allied to the Chalk than to the overlying strata.

In England, and generally in Europe, there is a marked discordance between the fossils of the Chalk and those of the overlying Tertiary rocks; no fossils (except, perhaps, one Terebratula) being common to the two groups. The gap between Cretaceous and Tertiary is, however, largely bridged over by North American and Indian strata.

The Eocene Rocks of England lie in two basins, those of London and Hampshire. Both are surrounded and underlaid by the Chalk. The London basin extends westward from the mouth of the estuary of the Thames to the neighbourhood of Marlborough, and northward till it is lost in the drift of Suffolk and Norfolk. The north boundary of the Hampshire basin runs from Beachy Head to the neighbourhood of Salisbury and Dorchester. The chalk downs near Newport, Isle of Wight, form its southern boundary. In both areas the Chalk and Tertiary strata are little disturbed except in the Isle of Wight and at Purbeck, where for a space they have been heaved nearly on end. The lower Eocene rocks lie sometimes on upper beds of Chalk, and sometimes on beds lower in the series. They are therefore highly *unconformable*, and in this we have the reason of the complete difference in the species of the Cretaceous and Eocene rocks, for great continental areas of Chalk were heaved above the sea, and remained as dry land for a period of time so long that when they were again submerged the life of Cretaceous times had died out, and other forms appeared.

The *Thanet Sand*, so named by Mr. Prestwich because it is well seen in the Isle of Thanet, lies at the base of the Cainozoic or Tertiary strata of England of the Eocene series. It consists of fine light-coloured quartzose sands, partly mixed with clayey matter. It usually lies on a layer of chalk flints of an olive-green colour externally, and which may partly represent the effect of the waste of the carbonate of lime of the chalk which was carried away in solution as bicarbonate of lime through the infiltration of rain-water after the deposition of the sands, the associated silica having been concentrated and deposited in this band. These sands range from the Isle of Thanet westward to the neighbourhood of London, varying from about 50 feet thick in parts of Kent to 4 feet at East Horsley, where they disappear, being overlapped by the Woolwich and Reading beds. They are quite unknown in the Hampshire basin. The fossils are entirely marine, and embrace about 70 known species. Among these are a shark of the genus Lamna, Pisodus, and others; a Nautilus; Gastropoda, such as Fusus tuberosus, Scalaria Bowerbankii, Natica, Aporrhais, &c., a considerable number of Lamellibranchiata, such as Nucula Thanetania, &c., Pholadomya Konrinckii, &c., Corbula, Cardium, Ostrea Bellovacina, &c. &c.; Crustacea, Hoploparia, and Palæocorystes; spines of Echini (rare), a coral, a few Foraminifera, and land-plants.

The *Woolwich and Reading beds*, formerly called the *Plastic Clay*, overlie the Thanet Sand, and rest directly on the Chalk when, as in the greater part of the London basin, and in Hampshire and the Isle of Wight, the Thanet Sand is absent. They may be broadly described as consisting of many wedge-shaped interstratifications of mottled clays, sharp light-gray sands, and pebble-beds made of chalk flints, which are sometimes loose and gravelly, and sometimes hardened into conglomerates. From west to east the strata vary from 15 to 90 feet in the London basin. In the Hampshire basin they are still less developed, and the whole consists of mingled marine, estuarine, and occasionally of purely fresh-water strata, marking the beginning of the influx of a great river, formed by the drainage of a continent, the result of the upheaval above the sea of large areas of Chalk and other older rocks. More than 100 species of fossils are known in the Woolwich and Reading strata, including an herbivorous mammal of a genus Coryphodon, allied to the modern Tapirs of South America, the bones of huge running birds (Gastornis) like the New Zealand Moas, turtles, and the scutes of a crocodile, several fish of the genus Lamna (L. contortidens, &c.), Lepidosteus Lepidotus, and Myliobatis; marine Gastropoda, such as Cerithium funatum, &c.; Fusus latus, Hydrobia Parkinsoni, Melanopsis brevis, &c.; Natica, Neritina, and others. Lamellibranchiata, not very numerous as genera and species, but plentiful as individuals, occur both in the sands and clays, including species of Arca, Cardium, Corbula, Cyprina Morrisi, Cyrena cordata, &c., Modiola elegans, Ostrea edulina or Bellovacina, O. elegans, &c.; Pectunculus, Psammobia, &c.; Crustacea and Foraminifera also occur.

A few land-plants have been found, as might be expected in estuarine strata, viz. Dryandroides Prestwichi, figs, laurels (L. Hookeri), Grevillia Heeri, and Robinia Readingensis; also fresh-water shells in true fresh-water strata, such as Paludina lenta, &c.; Planorbis lævigatus, &c.; and several of the genera Cyrena (C. cordata, &c.) and Unio, together with the small bivalve Entomostraca, Cypris and Cythere.

The *Oldhaven beds*, formerly included by Prof. Prestwich in the basement bed of the London Clay, lie between the above-named strata and the London Clay, consisting of fine sand containing rounded pebbles of flint. They are of inconsiderable thickness, but very constant in their occurrence. With the rarest exceptions the fossils are entirely marine; and they are numerous, consisting to a great extent of the same molluscous genera as those found in the Eocene strata below, with additions. A proportion of the species are also found in the overlying London Clay.

The *London Clay* usually consists of brown and bluish-gray clay with occasional bands of calcareous concretions (septaria). In the London basin it varies in thickness from 50 feet in the extreme west at Newbury to 480 feet in Essex. In the Isle of Wight, at Alum Bay, it is only 200 feet thick; in Whitecliff Bay, 295 feet; and at the west extremity of that basin in Dorsetshire it dwindles away, being barely distinguishable except to well-accustomed eyes. The chief fossiliferous locality in the Hampshire basin is at Bognor in Sussex. In the Isle of Wight fossils are scarce in this formation. Round London they occur at Highgate and in other places far to the west. The Isle of Sheppey has long been famous for its fossils, these being found there chiefly because of the frequent landslips from the cliffy slopes that overlook the sea. The plants have long been celebrated, consisting of various Palm-nuts (Nipadites ellipticus, N. umbonatus, see the plate, fig. 46, &c.) and other fruits; Coniferæ, many leguminous plants, laurels, figs, junipers, and plants of the citron tribe, &c., all of extinct species.

Remains occur of birds allied to the vulture (Lithornis vulturinus) and kingfisher (Halcyornis toliapicus), and a small swimming-bird, named Odontopteryx by Owen, with tooth-like serratures on the bill; turtles and river tortoises are numerous of the genera Chelone (breviceps, &c.), Emys (Conybeari, &c.), Platemys, and Trionyx; also a crocodile (Crocodilus champsoides) and snakes (Palæophis toliapicus and P. longus). Terrestrial mammals also occur—a Marsupial (Didelphys Colchesteri), a Bat, Hyracotherium cuniculus; Miolophus planiceps, Pliolophus vulpiceps, and Coryphodon eocænus—tapir-like animals.

Plants, birds, reptiles, and mammals all tell of the immediate neighbourhood of land, and the marine fossils now to be mentioned seem in fact to have lived at the mouth of a great river probably comparable to the Amazons. About 100 species of fish have been noted from the London Clay alone, including species of Lamna and many species of Rays (Myliobatis). Of the Cephalopoda, Nautilus (N. Sowerbyi, &c.) is common, together with the cuttle-fish Belemosis plicata, Belosepia sepioidea, and Beloptera Levesquei. Ammonites and Belemnites have disappeared. Gastropoda occur in vast profusion, the most prominent genera being Fusus (F. regularis, F. læviusculus, &c.), Murex (M. cristatus, M. coronatus, &c.), Pleurotoma (P. Helix, P. Keelii, &c.), Voluta (V. nodosa, &c.), Pyrula (P. Smithii, &c.), Cypræa (C. oviformis), and Rostellaria (R. ampla, &c.). Lamellibranchiata, though common, are less numerous, including among others the genera Pinna (affinis, &c.), Pholadomya (Dixoni, &c.), Arca, Avicula, Pecten, Cardium, Cyprina, Nucula, &c. &c. The Brachiopoda are only represented by Lingula tenuis and Terebratulina striatula, and there are a few Polyzoa. Crustacea are exceedingly numerous, especially crabs (Brachyura and Anomura), including the genera Xanthopsis, Hoploparia, &c., and of Entomostraca, Cythere is common of many species. Among the Echinodermata we have Hemiaster Bowerbanki, &c., Goniaster, Cidaris, Astropecten Colei, &c., Ophiura Wetherelli, and Pentacrinus, and there are also a few Corals. Many of the fossils of the London Clay are found in strata both above and below that formation, but a larger proportion is common to the overlying than to the lower formations.

The *Bagshot* and *Bracklesham Sands* and *Clays* succeed the London Clay. These are well shown on Bagshot Heath and on the coast of Hampshire. On Bagshot Heath they consist of light-brown and yellow sands, with beds of clay between, thus forming Lower and Upper Bagshot Sands, the whole, where thickest, being about 300 feet thick. The sands are very sparingly fossiliferous, but the clay in places contains a few species. In the Hampshire basin, at Bracklesham and other places, the lithological character of these strata is very inconstant, but they consist of the following series of strata, which are partly quite local:—

Upper Bagshot sands, &c.
Barton clay (quite local).
Bracklesham shells, sands, and clays.
Lower Bagshot sands and clays, with occasional lenticular beds of pipe-clay containing leaves, &c.

These strata have yielded about 200 species of fossils, mostly distinct from those of the London Clay. Many of the Gastropoda have a tropical aspect, such as Cypræa Bowerbankii, Murex minax, and Conus diversiformis. Gastropoda of these and other genera are exceedingly numerous, viz. Pleurotoma, Voluta, Natica, Ancillaria, Turritella, &c. &c. A large Oyster (O. picta), various Pectens, a great Cardita (C. planicosta), Cardium, Cytheræa, Solen sanguinolaria, &c., are common in England in the Bracklesham series, and a foraminifer (Nummulites lævigatus). In the same set of rocks there have also been found a serpent (Palæophis Typhæus, 20 feet in length, and P. porcatus), a turtle (Chelone trigoniceps), a crocodile (Gavialis Dixoni), and a tapiroid mammal (Lophiodon minimus), and fish, including Sharks and Sword-fish. The Bagshot Sands form the highest Eocene beds of the London basin. In the Hampshire basin, however, there are many newer formations.

The *Barton Clay* on the coast west of Lymington is quite a local deposit, and is especially fossiliferous, containing a few fish, a crocodile, C. Hastingsiæ, and more than 200 described species of marine shells. These have in general a tropical character. Among them are Nummulites, various large and small Volutas (V. athleta, V. ambigua, V. luctatrix, &c.), Murex minax, Rostellaria ampla and others, Buccinum, Triton, Turritella, Natica, and many others. Numerous Lamellibranchiate molluscs also occur, including Oysters (O. flabellula, &c.), Chama squamosa, Pectunculus deletus, &c., Arca duplicata, &c., Cardium porulosum, &c., Cardita, Panopæa, Catellus, Corbula, &c. &c. Near Poole Harbour land-plants occur in these strata in lenticular beds of pipe-clay, such as Oaks, Yews, Cypress, Spindle-trees, Dryandra, Laurels, Limes, Figs, Sennas, &c. &c., but all of extinct species. The Bagshot series, including all the strata mentioned above, form the highest part of the strata, containing marine shells exclusively.

Peculiar Eocene rocks are found in Britain at Bovey-Tracey, in the island of Mull and in others of the Inner Hebrides, as far north as Skye, on the mainland of the Sound of Mull, and in Antrim. The strata at Bovey-Tracey are lake deposits, and occupy a small area, about 6 miles long, covered by recent peat, at the south end of Dartmoor in Devonshire. The Antrim and Mull rocks are volcanic, intermingled with fresh-water beds, and the chief fossils in all of these areas are plants.

Numerous plant-species have been described from the Lignites of Bovey-Tracey consisting of Ferns (Pecopteris, Lastræa, &c.); gymnosperms (Taxodium, Sequoia, Pinus); angiosperms (Ficus, Oaks, Laurels, Birches, Willows, Water-lilies, &c. &c.).

In Antrim and Mull a similar flora occurs, but more restricted and more northern in type; and only two of the plants of Bovey-Tracey have been identified in Mull. In these regions the rocks consist chiefly of vast series of volcanic rocks, basalt, and volcanic ashes, interstratified with layers containing plants, &c. In Skye and the Faroe Islands similar

phenomena occur, with an analogous but still more northern flora, and the volcanic eruptions of Iceland date back to the same period. There, in beds of lignite called *Surturbrand*, are found the remains of Pines, Poplars, Elms, Plane-trees, Maples, Oaks, Tulip-trees, and Vines, in latitudes where nothing larger than dwarf-birches now grows.

OLIGOCENE. These form the great fluvio-marine deposits which constitute the remainder of the Tertiary rocks of Hampshire and the Isle of Wight. *Headon Hill Sands* (with Hordwell Cliff clays). Some of the marine shells of Hordwell are common to the Barton beds. Its marine strata contain Murex, Buccinum, Ancillaria, Voluta, Marginella, &c., Oysters, Pectens, Corbula, Balanus, sharks' teeth &c. (Voluta spinosa, fig. 47; Fusus porrectus, fig. 48; Oliva Branderi, fig. 49; and Nummulites lævigata). The brackish-water strata have yielded Cerithium mutabile, C. cinctum, Potamomya plana, &c., and the fresh-water rocks contain Paludina lenta, Planorbis euomphalus, Limnæa caudata, Cyclas, several species of Cyrena, Unio Solandri, Melania, &c., besides land-shells of the genus Helix, and of vegetable remains, two species of Carpolithes (a conifer), and Chara Wrightii (Forbes). In the Hordwell Cliffs and elsewhere numerous reptiles have also been found, including two serpents (Palæophis depressus, and P. rhombifer), Turtles, and seven species of Trionyx; Crocodilus toliapicus, and Alligator Hantoniensis. Among the mammals of the same beds have been found Palæotherium annectens, a three-toed animal somewhat like a tapir; Anoplotherium commune, having affinities both with pigs and ruminants; Chæropotamus Cuvieri, like the river-hog; Dichodon cuspidatus and Microchærus erinaceus; also a bird (Macrornis tanaupus).

The *Osborne Beds* succeed the Headon series, and are well seen on the coast near Osborne, and at Nettlestone, in the Isle of Wight. Different sections vary in lithological character, but they may be generally described as consisting of sands and clays, from 60 to 80 feet thick, containing fresh-water shells, such as Cyrena obovata, Achatina costellata, Limnæa longiscata, Melania costata and excavata, Melanopsis brevis, Paludina lenta in great numbers, and P. globuloides, Planorbis euomphalus and five others, and a Unio. Entomostraca (Crustacea) also occur, Candona Forbesii, Cytheridea Mullerii, and Cythereis unisulcata, with fresh-water plants Chara Lyellii and medicagulina. A land-shell, Helix occlusa, and a Cerithium are also found, the latter of which may have lived in brackish-water, but the general assemblage is entirely fluviatile.

The *Bembridge Beds* overlie the Osborne series in the Isle of Wight, and 'spread over the greater portion of the surface of the island which is occupied by Tertiary deposits' (Bristow). They are fluvio-marine, and consist at the base of a soft cream-coloured fresh-water limestone, sometimes 20 feet thick, overlaid by an Oyster band, which is succeeded by about 40 feet of marls. The limestone is a remarkable stratum, containing numerous fruits of Chara, fresh-water shells, viz. Limnæa longiscata, Paludina globuloides, Planorbis, Melania, and of land-shells five species of Helix, Bulimus ellipticus, Pupa perdentata, and Cyclotus cinctus. Above this bed is a characteristic oyster-band with Ostrea Vectensis, and this is succeeded by marls in different bands highly charged with Paludina lenta, Limnæa longiscata, Bulimus, Melania, Unio, Cyrena semistriata, C. obovata, and other fresh-water and brackish shells. In the Bembridge beds there has also been found the Anoplotheroid mammal Dichobune cervinum, and five species of Palæotherium, viz. P. crassum, curtum, magnum, medium, and minus.

The *Hamstead Beds* form the uppermost portion of the British Oligocene strata. The beds below pass gradually into them, and the fossils throughout the lower part of the Hamstead series are in great measure identical with those of the Bembridge marls, containing Paludina lenta in profusion, Planorbis obtusus, Limnæa, Cyrena semistriata, Unio, Melania, &c., and at the very top is a marine band containing Corbula pisum, and Oysters. The mammalia Hyracotherium leporinum and Hyopotamus bovinus and H. Vectianus (Suidæ) occur in these strata. These Hamstead beds were first clearly described by Edward Forbes, who considered them Eocene. Sir Charles Lyell, however, because of certain land-plants, considered them Lower Miocene. Forbes's views are now accepted, but his 'Upper Eocene' is called Oligocene (Upper part absent in Britain). In Hampshire the same general series of fluvio-marine strata occurs, with variations in lithological character, but only as high as the Bembridge beds, the Hamstead strata having been removed by denudation.

The most natural classification of the whole of the English older Tertiaries seems to be as follows:—

Oligocene, including all the fresh-water strata, with occasional marine interstratifications, from the base of the Headon sands to the top of the Hamstead beds.
Upper Eocene, including the Upper Bagshot, Bracklesham beds, and the Barton Clay.
Lower Eocene, including the marine, estuarine, and fresh-water strata of the Thanet sand, Woolwich and Reading beds, London Clay, and Lower Bagshot.

Taken as a whole they may all, in the widest sense, be spoken of as estuarine, for even the London Clay was evidently deposited in the broad mouth of a great river like the Amazon or the Ganges; and nearly all the strata more or less contain evidence of land, in fresh-water reptiles, birds, mammalia, and land-plants.

In France, in the Paris basin, the older Tertiaries are largely developed. The Thanet Sands and Woolwich and Reading beds (*Argile plastique*) are there much as in England. In the latter a large running bird was found (Gastornis Parisiensis) nearly as large as an ostrich. The London Clay is absent except in a small patch near Dunkirk. The shelly strata (*Lits coquilliers*), which are generally considered to come next in succession, are absent in England; and the *Calcaire grossier* is the general equivalent of our Bagshot and Bracklesham beds, and contains many of the same species of sea-shells. According to Lyell the *Grès de Beauchamp* represents the English Barton Clay, and the *Calcaire silicieux* represents the Headon series, while the Gypseous series of Montmartre ranks with our Bembridge beds. In France the Hamstead beds are absent.

MIOCENE.—Absent in Britain. The largest district that has been carefully described, containing many plants, is in Switzerland, between the Alps of the Oberland and the Jura.

The Central Alps, formed of Palæozoic, Secondary, and Eocene strata, formed a mountain range before the Miocene epoch began; and accordingly the lower Miocene conglomerates now forming the Righi and other sub-Alpine hills are found to consist of pebbles formed by the waste of the older mountains. The Swiss Miocene rocks in general have been divided into Lower fresh-water strata, of great thickness; Middle marine strata, occurring on several horizons interstratified with fresh-water beds, with sea-shells; and Upper fresh-water strata. Near the older mountains the strata are generally hard and rocky; the upper strata are often soft and marly, and they are often called *Molasse*.

More than 500 species of land-plants from these

Lower Miocene beds have been described by Professor Heer, including Tulip-trees, Cinnamon, Hornbeam, Buckthorn, Yew, Figs, Cypress, Sequoia, Dryandra, and Palm-trees, including Fan-palms. Flowering plants are very numerous.

Above these beds come the Middle marine strata with many sea-shells, of which the present writer has not been able to find any list. It is stated by Lyell that 'a large number of the shells are common to the faluns of Touraine, the Vienna basin, and other Upper Miocene localities'; and, according to the same author, about 25 per cent of the shells of the faluns are of living species.

The *Upper Miocene Beds* contain a flora in many respects similar, viz. Cinnamon, Poplars, Willows, Maples, Plane trees, Yews, Podogonium (a papilionaceous genus), Vines, and Proteaceæ, allied to those of Australia, and of certain Cretaceous strata, and Glyptostrobus like that of Japan, &c. &c. 900 species of insects have been described from these strata, the remains of which were deposited when the plants were in flower; and winged ants were numerous. A large elephantine mammal, Mastodon angustidens, occurs in the same strata. The whole assemblage indicates a warmer climate than that of Switzerland of the present day; and the vegetation is perhaps most nearly comparable with that of the southern and warmer part of North America. All of the species, or nearly all, are said by Professor Heer to be extinct; but this may be doubted, some being very close to living forms. It is obvious at all events, in the east, near and beyond the Lake of Constance, that the plants found in the Lower Miocene beds lived round a great lake, into which they were washed; that occasional partial submergence of the area took place when the marine beds were formed; and that on re-emergence in an area occupying the same general area as that which preceded it, the Upper Miocene fresh-water strata were deposited. Miocene rocks also occur on the south side of the Alps, analogous to those of Switzerland. A similar flora is found in Bohemia in the thick Lignite beds near Teplitz and elsewhere, above which are shales with Cypris; and also on the Rhine near Breul, and in other continental districts.

In Spitzbergen a rich flora of Miocene age occurs, and also in Greenland far north of the Arctic Circle.

In Central France, in the districts of Auvergne, Cantal, and Velay, there are certain lacustrine strata, the lower part of which is formed of Lower Miocene beds containing Crocodiles, Tortoises, Birds, and mammalian remains, one of them probably identical with Palæotherium magnum of the Eocene strata in the gypsum beds of the Paris basin. The upper strata of Miocene date were accompanied and followed by volcanic eruptions, of which the evidences remain to this day in great lava beds, volcanic ashes, and hills with crateriform summits more or less perfect. Besides leaving their remains in the ordinary strata, during eruptions some of the animals of the period were buried in showers of ashes, viz. Rhinoceros, Mastodon, Tapir, and several genera of extinct Carnivora. Paludina, Planorbis, Cypris, Caddis-worms, and other fresh-water remains, occur in the strata with which these are associated.

Between the mouth of the Loire and the neighbourhood of Tours, and in other districts, the country is more or less covered with patches of marine shelly marls, known as the *Faluns* of Touraine. They contain about 26 per cent of recent shells, and the whole fauna seems to have been such as might have lived in a sea warmer than the Mediterranean of the present day. Some of the shells are large species of Cypræa (Cowries), eight species of Conus, tropical-looking species of Nerita, Oliva, Mitra, Terebra, &c. These, and various fresh-water deposits in Aquitaine, also contain many mammalian and other fossils; among these are a Monkey (Protopithecus), Bats, Shrews, Desmans, Moles, Hedgehogs, the Taxodon, Weasel, Civet, Squirrel, Myopotamus (somewhat resembling a beaver), the Pika, Arvicola (vole), Dormice, Cricetodons, the Gerbil, Macrotherium (one of the Edentata), the Rhinoceros, Pig, Chæromorus, Hippopotamus, Chæropotamus, Dinotherium, Mastodon, Deer, Dichobune, Antelope, Musk-deer, various Cetaceans, such as the Dolphin, Morse, Sea-calf; Reptiles, including Turtles, Crocodiles, Lizards, Serpents, Batrachians (frogs, &c.), and numerous fish, all, from first to last, of extinct species.

In the islands of the Ægean Sea Miocene beds occur at a height of 2000 feet. Malta is made of Miocene rocks containing Elephant remains and those of many other mammalia. An important Miocene area also lies in the valley of the Rhine, between Mayence and Basel. Miocene beds also exist in North America.

Over many parts of Europe, Asia, and America there are other Miocene strata too numerous to name, and each more or less possessing peculiarities. During this epoch these continents in fact existed, and were of great extent, though different in details of physical geography from those of the present day; and, though all of the mammalia and most of the plants are said to be of extinct species, both flora and fauna are to a large extent entirely of existing types.

The PLIOCENE STRATA in Britain consist of—

Chillesford Clay.
Norwich Crag and Red Crag.
Upper Coralline Crag.
Lower Coralline Crag.

The *Coralline* or *White Crag* lies on the London Clay in Suffolk, and consists of a patch of about 20 miles in length, and generally of less than 100 feet in thickness. Patches also occur in the North Downs and in Cornwall. It is rich in Polyzoa (formerly called Corallines, whence the name), and consists in great part of broken and entire shells, fragments of Echini, &c. Only 4 genera of Corals are known, all, according to Mr. Etheridge, of extinct species, and the same authority gives about 140 species of Polyzoa. The genera of most of its shells are recent. The general character of the climate seems to have been milder than at present.

According to the researches of Mr. Searles Wood, modified by Mr. Gwyn Jeffreys and Prof. Prestwich, the Coralline Crag contains 415 species of Mollusca, as against only 5 Brachiopoda, Argiope cistellula, Lingula Dumortieri, Orbicula lamellosa, Terebratula grandis, and Terebratulina caput-serpentis. Cardita senilis, Astarte Omalii, Pecten opercularis, and Voluta Lamberti are characteristic molluscs. Of the 415 species some 169 are said to be extinct. Sixteen species of Echinodermata are known, 6 of which are still living; and fish are found identical with living species of Cod, Pollack, and Whiting, together with large teeth of a shark, Carcharodon megalodon (see plate, fig. 55), Otodus, Raia antiqua, &c. It is possible that the Coralline Crag may be nearly of the same age as the marine shell-beds of the Faluns of Touraine, commonly called Miocene.

The *Red Crag* often lies in denuded hollows on the Suffolk Crag, and is chiefly a ferruginous, shelly sand, very irregularly bedded. 140 species are common to the Red and Coralline Crag. Of 234 species of shells, 150 now live in British seas, while '32 are now restricted to more southern and 23 to more

northern seas' (Prestwich). In all about 92 per cent of the Mollusca are said to be still living. Of 25 species of corals, 14 still inhabit our coasts. Among its characteristic shells are Trophon antiquus, Fusus contrarius (see plate, fig. 54), and various species of Murex, Voluta, Buccinum, &c. In it are also found teeth of Sharks, vertebræ of other fish, and many ear-bones and occasional vertebræ and other bones of whales (ear-bone of Balæna emarginata, see plate, fig. 56), together with numerous other phosphatic remains. So plentiful are these that they can be profitably worked for manure. Among them are the bones and teeth of many land mammalia of extinct species, Castor veterior (beaver), Cervus dicranoceros (deer), Equus plicidens (horse) and Hipparion, Hyæna antiqua and Felis pardoides, Mastodon Arvernensis, M. tapiroides and Elephas Meridionalis, Rhinoceros Schleicrmacheri and Sus antiquus. Similar phosphatic remains, though fewer in number, have been found with bones of whales at the base of the Coralline Crag at Sutton. In both cases many of the bones, &c., are worn and mineralized.

There are many reasons for believing that during the later part of the Oligocene, and through Miocene times, the area now called Britain was joined to the Continent. The physical geography of the country was different, with, however, a general identity in so far that the Palæozoic mountainous regions now were mountainous then. In late Miocene times mammalian races inhabited our region, and their bones got scattered on the surface and buried in alluvia. A partial submergence of the country took place, so that Britain became for a time an island, and the marine Crag beds were deposited over part of an eastern area the relics of which still remain in Norfolk and Suffolk. Some of the mammalia survived this partial submergence, and continued to inhabit the island during Pliocene times, and, getting associated with varieties and new species, the relics of all were washed into the basement beds of the above-named Crag formations during various oscillations of level.

The *Mammaliferous* or *Norwich Crag* consists of sands, gravels, and shells, generally only a few feet in thickness, and which, in Norfolk, lie upon the Chalk. Both Red and Norwich Crags are overlaid by the *Chillesford Clay*, the marine shells of which are related to those of the Norwich Crag. From the nature of the fossils of the Norwich Crag it is believed to have accumulated near the mouth of a river. The Norwich Crag is never seen in contact with or overlying either the Coralline or Red Crag. Following the views of the late Prof. Prestwich it is held to be of the same age as the Red Crag, having been accumulated in an area partly estuarine, and separated from the purely marine area of the Red Crag by an emerged district consisting of the Coralline Crag.

In the Norwich Crag 139 species of marine Mollusca are known, of which 87 are common to the Coralline Crag, 137 to the Red Crag, and 93½ per cent are still living. 'Comparing the three Crags the proportions of extinct species of marine Mollusca are: Coralline Crag 16 per cent, Red Crag 7·7 per cent, and Norwich Crag 6·5 per cent' (Prestwich). It contains about 20 species of land and fresh-water shells, such as Helix, Planorbis, Paludina (P. lenta, &c.), Pupa, Limnæa, Cyclas, Cyrena, &c., all of which are of living species. Besides these, there are found in it the bones of Mastodon Arvernensis, Elephas meridionalis (?), E. antiquus, and Hippopotamus major (?), together with the Horse Equus fossilis, Castor fiber (beaver), the common Otter, Deer, &c. The Chillesford Clay may be considered to belong to the same general period, and its fossils are mostly recent.

Notwithstanding a certain admixture of southern with northern forms of shells in all the divisions of the Crag, according to Prof. Prestwich, the climates were sufficiently cold to admit of the transport of pebbles and large stones by the occasional agency of coast ice. In many other countries, as in Belgium, there are deposits of this date. In Sicily, strata occur 3000 feet above the sea, containing shells, 20 per cent of which are extinct.

In Norfolk, the well-known *Forest bed*, the first of the strata belonging to the PLEISTOCENE or QUATERNARY Epoch, is occasionally seen to rest upon the Chillesford Clay, and to be overlaid by the *Boulder-clay*. It consists of dark sandy clay, above which there is a bed of coarse gravel, known as the *Elephant bed*. The Forest bed is so called because of the remains of trees with which it abounds, namely, Scotch Firs, Pines (Abies excelsa), Yews, Sloes, Buckbeans Oaks, Alders, &c., and besides these, the common Water-lily, the Yellow Water-lily (Nuphar lutea), Hornwort, Pondweed, &c. The mammalian remains of the Forest bed and overlying gravel are of special interest, because a number of species new in our area appear. The forms already known are Elephas antiquus, especially of the variety known as E. priscus, E. meridionalis, and possibly E. primigenius, Rhinoceros megarhinus, Rh. Etruscus, Hippopotamus major, the common Horse, Bison priscus, the Aurochs (Bos primigenius), Red-deer, Roe-deer, Cervus megaceros (Irish Elk), C. Sedgwickii, C. Poligniacus, C. Ardeus, various Shrews, the field-mouse, the common beaver, Trogonotherium Cuvieri (a great beaver), Machairodus (a tiger?), the White bear, Ursus spelæus (Cave bear), U. Arvernensis, and U. Etruscus, and a pig, Sus Savernensis.

The physical history of these beds was probably somewhat of this kind. During the deposition of the Crag formations Britain was severed from the Continent by partial submergence. A new emergence rejoined it to the Continent, and this was accompanied by migration into the British area of a flora and fauna to a great extent new, which intermingled with the older forms that still inhabited the land.

Bone Caves.—It is probable that many of the fossils found in the celebrated bone caves are of the same general date with the Forest bed. As, however, they have been liable to be inhabited and to accidents at various periods, some of the remains found in them must belong to later times. These caves in Britain are in limestone, and were excavated by help of the percolation of rain water charged with carbonic acid derived from the air, and which carried away part of the carbonate of lime as a soluble bicarbonate. The most noted examples occur at Kirkdale, in Yorkshire; the Dream Cavern, in Derbyshire; Banwell Cave, in the Mendip Hills; on the coast of Gower, Glamorganshire; Caldy Island, in Pembrokeshire; Kent's Hole, near Torquay; Oreston, near Plymouth; Cefn, near St. Asaph, &c. Their floors are often covered by beds of stalagmite, formed by the dropping of water from the roofs, bearing bicarbonate of lime in solution. The water partly evaporating, a portion of the lime remains in stalagmitic layers. In the British caves 66 species of mammalia have been found, mostly in muddy and sandy layers under the stalagmite. The Kirkdale cave affords a good example. Taking these caves as a whole, they contain bones and teeth of the Brown Bear, the Grizzly Bear, the Cave Bear (Ursus spelæus), the Glutton, Otter, the Ermine and other weasels, the Badger, the Cave Hyæna (H. spelæa), Fox, Wolf, Cat, Panther, Lion, Lynx, Machairodus latidens (sabre-toothed tiger), the Shrew-mouse,

Rhinolophus ferrum-equinum (a Horse-shoe Bat), Reindeer, Roe, Red-deer, Cervus megaceros, C. Brownii, the Elk, the Aurochs, Bison priscus, the Pig, Hippopotamus major, Rhinoceros leptorhinus, Rh. tichorhinus, the Horse, Elephas primigenius (commonly called the Mammoth, an old variety of the Indian Elephant?), E. antiquus, Hares, Lagomys spelæa (Pika), living species of Voles, and the Beaver (Castor fiber), &c. The works of man, such as flint implements, and on the Continent his skull and other bones, have been found in caves associated with the above-named mammalia. The bones of the ruminants and pachyderms often bear the marks of teeth, having been gnawed by the Hyænas, which for many generations inhabited the caves. In the Kirkdale cave alone remains of 300 Hyænas were observed. Similar caverns occur in many other places in Europe, Asia, and America, each containing bones of genera typical of the area in which they are found; that is to say, of species often extinct, but allied to those that now inhabit the continents in which the caves occur. Those in Australia contain marsupial remains, some of them much larger than any living species.

The Glacial Epoch.—The signs of this old period of extreme cold in what are now temperate regions have been made out by the study of the glaciers of the Alps, Greenland, Victoria-land, and other regions, and of the effect of the fleets of icebergs that float south into the Atlantic from Greenland, and north from the Antarctic continent of Victoria-land, and the Straits of Magellan. We have already mentioned the effect of glaciers in producing *roches moutonnées*, striations, and moraine mounds, with ice-scratched stones (see also GLACIERS). Whenever, therefore, we find such phenomena in countries where there are no glaciers now, it may safely be concluded that glaciers once were there.

In the Highlands of Scotland the mountains, though now rendered in part rugged, jagged, and scarred, are yet often rounded and flowing in great and small mammillated curves. The same curves prevail in the valleys and even in the Lowland districts of Scotland, and in Cumberland, Wales, and other hilly districts in the north of England. All the mountain regions of Europe show the same signs, the Scandinavian chain, parts of the Jura, the Black Forest, the Vosges, and the mountains of Granada, and in Africa they have been noticed in the Atlas. All the northern half of North America is covered by them, and indeed in all great mountain chains, such as the Alps, the Himalaya, the Altai, and in Scandinavia, it is observable that the glaciers were once prodigiously larger than at present. The whole of the Lowlands of Switzerland were once covered by glacier ice, which indeed at the same time intruded itself far across the plains of northern Italy. The indications that prove this could only have been produced by the moving ice of glaciers. In the southern hemisphere the same phenomena prevail, and there were therefore periods of extreme cold alternating between north and south.

It was in one of these periods that what is now the British Islands was in great part covered by glacier ice, probably as thick as that of the north of Greenland at the present day. When the most extreme cold prevailed, our mountains were literally smothered in ice. That of the Highlands flowing eastward joined a vast body of ice coming west and south from Scandinavia, while in the opposite direction a great ice-sheet flowed westward and overspread what is now the Island of Lewis and other islands of the outer Hebrides. From the Grampians a thick ice-sheet overspread the valley of the Tay, and partly flowing east and partly across the Ochil Hills, it invaded the valley of the Forth. Another part passed into and filled the Firth of Clyde, aided by the ice of the mountains of Arran, and joining that of the Carrick Hills and part of the glacier masses of Cumberland, filled what is now the shallow area of the Irish Sea, overflowing Anglesey, where it was recruited by the glacier ice-flow of North Wales. Much of the lower Boulder-clay or Till is, in the opinion of Prof. James Geikie and others, simply the *moraine profonde* of this great ice-sheet.

It is possible that during part of this period the whole of Britain, by general upheaval, may have stood higher above the level of the sea than it does at present; and it is probable that by oscillations of temperature the ice-sheet may have varied in size, so that in some degree there were in places what Prof. James Geikie calls inter-glacial periods, when the glacier masses declined in size. It was formerly believed (but the view is now discredited) that during parts of the Glacial epoch those rock-bound lake basins were formed by the scooping power of ice, which in vast numbers, large and small, overspread all regions that on a great scale have been subjected to the power of glacier ice.

At length a slow submersion of the land took place, and, as it sank, glaciers, declining in size, still descended to the sea, in which they deposited their moraines. As the land sank more and more the cold still continued, and icebergs like those of Greenland broke off from the glaciers, and, mostly floating south, deposited their stony freights over part of what is now the low lands of England and other regions, and of neighbouring seas. Sands, gravels, and clays, full of boulders and ice-scratched stones, occur as far south as the low table-lands north of the estuary of the Thames, and in Scotland, Lancashire, Cheshire, Holderness, Carnarvonshire, and elsewhere these are often intermingled with shells of Arctic or semi-Arctic type sometimes lying at heights of from 800 to 1200 and 1400 feet above the present sea-level. Many geologists, however, are opposed to the submergence hypothesis, and the matter cannot be regarded as settled. The same kind of phenomena are more or less universal over great part of Northern Europe and North America.

As the land rose after the submergence, the glaciers began to increase in size, though they never reached their former magnitude, and the evidence of these latter glaciers in the mountain lands is perfect. In some cases the drift that had partly filled the valleys was ploughed out by the descending ice. Many of the greater valleys of the Highlands of Scotland, of the north of England, Ireland, and Wales, were at this period filled with glacier ice. In Wales it has been shown that the Passes of Llanberis and Nant Francon were filled with ice 1300 feet thick, which descended from the mountain regions of which Snowdon forms the highest peak. The evidences are to be found in the polishing, scratching, grooving, and deep furrowing of the rocks over which the glaciers flowed, and as in the Alps, where a tributary glacier flows into a greater ice-filled valley there will be a set of branching furrows, so in the Passes of Llanberis and Nant Francon, and in many a Highland valley, a series of grooved lines are often found branching from the general direction of the grooves that mark the bottom and sides of the main valley. The moraines, both lateral and terminal, left by some of those ancient glaciers, are still more or less perfect. They may be seen in Wales, in Cwm Idwal, Cwm Graianog, and other tributary valleys of Nant Francon at Llyn Llydaw, Cwm-y-llan, Cwm-glas, and other valleys on the flanks of Snowdon; in the valleys of the Cuchullin Hills in Skye, at Ben More,

Coigach, and Glen Messan, in the Island of Arran, in the valleys of the Carrick and Moorfoot Hills, and in Cumberland. A few of the mountain lakes in these regions have been produced by natural dams, formed by ancient moraines. As the climate ameliorated, the glaciers gradually decreased in size, and in many cases moraine within moraine may be traced, till at length the last traces of glaciers are discovered in the relics of tiny moraines, but rarely visited, among the highest recesses of the mountains. Another sign of glacial action in such valleys is the frequent occurrence of well-rounded *roches moutonnées*, sometimes small, sometimes of the dimensions of little hills. These are well smoothed, scratched, and grooved, but often decay has obliterated their polish and markings, and the general form alone remains. A broken unrounded side frequently faces down the valley, as in the Alps now. They are also often plentifully sprinkled with great boulders (*blocs perchés*), sometimes, as in the Pass of Llanberis, occupying such precarious positions that it is evident nothing could have deposited them there except the gentle thawing of the ice on which they lay. The same kind of phenomena connected with shrinking glaciers are strikingly observable in the mountains of the Vosges, the Black Forest, the Alps, the Himalaya, and many other regions, including New Zealand.

There seems reason to believe that Elephas primigenius (see the illustration), along with other mammalia, some of which are still living, inhabited this region both before and partly during the Glacial epoch. At all events, the remains of this great hairy elephant (often called the Mammoth) have been found in the boulder-clay of Scotland, in Holderness in Yorkshire, and elsewhere. During the times of extremest cold, they must have retreated from the greater part of the region, unless it may be that some of them inhabited the southern part of England. The same remark applies to the episode of greatest submergence. However this may be, it seems certain that on the re-elevation of the country Britain was re-united to the Continent, and Ireland to Britain, by plains of boulder-drift, across which many mammalia migrated into our area, some of them for the second time. It is unproved whether or not man inhabited any part of Europe in pre-glacial times, but there can be little doubt that he also migrated into the British area along with such mammalia, for both in France and England his works, flint weapons, and more rarely his bones, are found in river gravels and in caves, associated with the relics of extinct mammalia. This fact was first proved for the rivers in 1847 by Boucher de Perthes of Abbeville, who, in the ancient gravels of the Somme, found the teeth of the Mammoth along with unmistakable flint hatchets of a rude and ancient type. Long ago the same kind of association was proved in the limestone caverns near Liége by Dr. Schmerling.

It is quite possible that some parts of the gravels and brick-earths of the southern part of England may be of pre-glacial age, but the physical evidence seems in the main to show that the low country valleys, such as the mouth of the Thames and the Ouse of Bedfordshire, &c., are chiefly of post-glacial date. However this may be, it is certain that the mammalian remains of the river deposits are to a great extent identical with those of the bone-caves. They consist of the following species, most of which are still living:—White and Cave bears, Ermine, Otter, Fox, Wolf, Hyæna (spelæa), Lion, Red-deer, Reindeer, Cervus megaceros (shown in fig. 58), Musk-sheep, Ox, Bison, Horse, Pig, Rhinoceros leptorhinus and Rh. hemitæchus, Elephas primigenius and E. antiquus, Hare-rat, a Squirrel, and the Mouse.

At the time of the deposition of many of these river alluvia (which often contain flint-weapons and fresh-water shells) it is certain that many of the rivers, such as the Thames and other rivers of the east of England, were much longer than at present, and, flowing through the great plains of boulder-drift, may have been tributaries of the Rhine, then flowing north through the same plain. At length, however, these plains formed of soft clay were broken up, and the remains of that old land may be still seen in the plain of Holderness, and in Norfolk and Suffolk, undergoing annual destruction by landslips on the shore, and the power of the sea. Many of the larger mammalia of the above list disappeared before the historical epoch, probably hunted down by man, though the Reindeer still lingered in Caithness within the times of history, and in Irish tradition there are traces of the Cervus megaceros under the name of the Horned Horse, which, in the opinion of the late Dr. Scouler, may have been the animal mentioned as the *Schelch* in the Nibelungen Lied. The Cervus megaceros and other remains are often found in the shell deposits of old lakes, under peat-moss in Ireland, and the Isle of Man.

Almost every country has an assemblage of Mammalia in its old river deposits analogous to those described above. The *Loess* of the Rhine is a soft, fine, light-brown calcareous mud rising on the slopes high above the modern alluvia of the river, with marsh and land shells such as Succinea elongata, Pupa muscorum, and species of Helix, H. nemoralis and H. hispida, along with teeth and bones of the Mammoth, Horse, &c., and in similar deposits on the Meuse, it is said, skeletons of man. Loess is present on a large scale in China, and was probably accumulated by wind-action. Similar deposits forming the bluffs of the Mississippi contain bones of the Megatherium (a gigantic ground sloth), Mylodon, Megalonyx, Mastodon, Horse, Ox, &c., all of extinct species. The land and fresh-water shells found in both these ancient deltas are of recent species. Other similar cases could be cited.

All these changes were accompanied by numerous oscillations of level, producing important modifications in the distribution of sea and land, and they were likewise all attended by the destruction and introduction of new species, so that in late times we find existing mammals mingled with others that have long been extinct. Some of the last changes are marked by submerged forests and raised beaches. The shells in these beaches are all of recent species. The same kind of changes are still going on, and on the western coasts of South America works of art have been found mixed with shells in an old sea bottom raised 40 feet above the sea. The same kind of deposits rise in the same country 1300 feet above the sea. Similar phenomena occur on the shores of the Bay of Naples. Some of these comparatively recent but prehistoric phenomena, such as the shell-mounds or *kitchen-middens* of the old inhabitants of the coast of the Baltic and the villages built on piles in the Swiss and other lakes, may be said to belong to the domain of Archæology rather than of Geology, and in less degree the same may be said of the Caves of Dordogne and other parts of the south of France, in which Felis spelæa and Cervus megaceros are found, and reindeer horns and tusks of the Mammoth with their own figures rudely carved upon them. Each of these minor epochs has its own kind of flint implements of different degrees of finish and polish, called respectively Palæolithic and Neolithic.

It took a long time to establish all the facts and

reasonings now accepted by geologists, but the chief advances have been made in the last hundred years, beginning with Hutton and William Smith. Notices occur in the pages of Herodotus, Aristotle, Strabo, and Pliny, which scarcely amount to geological ideas, but which show that they were cognizant of the occurrence of shells far inland and high on the mountains; and they also reasoned on the mutability of the relative levels and positions of sea and land. In the fifth century, Orosius, a Spanish divine, recognized the true nature of fossil shells, and referred them to the Deluge: and this opinion for long obtained among such men as Lister (1683), Burnet (1690), Woodward (1695), and many more. Others, in England, France, and Italy, held the more absurd opinion that they were 'sports of nature'. A few remarkable men held more correct views on the subject. In 1580, Palissy, 'a potter, who knew neither Latin nor Greek, was the first who dared assert in Paris, and to the face of all the doctors, that fossil shells were true shells, deposited formerly in the sea in the places where they are found, . . . and he stoutly defied all the school of Aristotle to attack his proofs'. In 1669 Steno published his treatise De Solido intra Solidum Naturaliter Contento, in which he demonstrated that plants, shells, and teeth found in rocks are truly organic; and that they were buried in marine sediments, in the same manner that the remains of plants and marine animals are now entombed in modern sea bottoms. Hook, in his Discourse of Earthquakes (1688), maintains like opinions; and he inferred the extinction of species, and the introduction of varieties, consequent on changes in physical geography. Still further, he speaks of the 'records of antiquity which nature has left as monuments and hieroglyphic characters of preceding transactions; . . . and though it is very difficult to read them, and to raise a *chronology* out of them, . . . yet 'tis not impossible'. This is the earliest distinct hint of the principle of *succession of life in time*. In 1760 Mitchell, in his Memoir on Earthquakes, shows a clear perception of an order of superposition in strata, but he does not combine it with the fact of a parallel succession of life. A physician of Rudolstadt, George Christian Fuchsel, had a partial knowledge of both these facts, and his writings contain the germ of the truths that, during the nineteenth century, have given so rapid an impulse to the science. Rather later, Werner, by his enthusiasm, eloquence, and skill as a mineralogist, also lent some aid to the cause; but his bigoted adherence to the dogma that all rocks are aqueous did much to retard the advance of truth. His far greater opponent, Hutton (1788), in his Theory of the Earth, expounded the true doctrine, which may be summed up as follows:—

1st. That in the geological history of the world the course of events has never been disturbed by universal paroxysmal catastrophes, but that the course of change has been similar to that in the existing economy of nature.

2nd. That we know of no set of igneous rocks that can be proved to be of generally older origin than the earliest stratified deposits, but that *they may often be proved to be* of posterior origin.

3rd. That the stratified masses *were formed from the waste of pre-existing rocks, mingled with organic exuviæ.*

4th. That such strata afford a measure of the amount of pre-existing land destroyed to afford materials for their formation.

5th. That there may be a progressive formation of rocks in the bottom of the sea, contemporaneous with great and repeated alterations of lower strata, that approach the regions of internal heat (metamorphism).

6th. That all strata being derivative, and a machinery existing capable alike of erecting and destroying rocks, in the whole course of *visible* nature 'we find no vestige of a beginning—no trace of an end'.

To these grand generalizations William Smith, 'the father of English geology', added the complete proof of the *succession of life in time*, proving, as he did, in England a clear succession of strata, each more or less characterized by its own suite of fossils; and thus gave to a great extent a perfect clue to the reading of that chronology on which Hook speculated. Smith died in 1833. The doctrines of Hutton and Smith combined gave the key to great part of the modern system of geology, which is now permeated by evolutionary ideas, chiefly as a result of the influence of Darwin and his school.

Note.—The section shown in coloured plate (I.) is merely diagrammatic, but is intended to show, among other things, that the sections of strata from the surface downward vary greatly at different localities, while the sources of volcanic supply far down within the crust, and also the deep-seated nature of plutonic rock, are indicated. The oldest rocks, the pre-Cambrians or Archæans, are met with in the west of Britain. The Cambrians and Ordovicians which occupy so great a space in Wales are represented as continuous under the middle of England to Harwich, where they approach the surface, thence into France, where they appear on the coast, and on towards Italy. They are traversed at Snowdon by lava, which, besides being intrusive among the strata, also flowed out at a crater, the ashes round which are still recognized. The lava is represented in communication with a subterranean molten mass of undefined size. This, possibly temporary, fluid cavity, like that below Vesuvius, is shown as continuous with areas of altered rocks in two ways: 1, the granites may be the product of igneous fusion; 2, they may be the product of metamorphism, as suggested at the Alps, where from the granite there is a transition through gneiss into schist, thence into unaltered Cambrian rocks. The intrusive mass represented under the Plains of Lombardy is intended to show how molten rock may appear at the surface, exposed by denudation, though it was never poured out from a crater. The Carboniferous strata rest on the dark purple Silurians, the Old Red Sandstone being omitted, as that series of lacustrine deposits does not appear in force in this particular line of horizontal section. The Carboniferous are supposed to have been deposited around the mass of Protozoic rocks, on whose summit the Straits of Dover are hollowed out, and the Limestone and Coal Measures thus reappear in the centre of France. The Permian are a very local set of deposits; the Trias, on the other hand, ranges into the Alpine region. The Secondary strata, Oolite and Chalk, spread throughout Europe, though the relative quantities of these deposits vary in different localities. The Tertiary strata are very limited in England, and seem generally confined to the low grounds of Europe, but their presence near the summit of the Alps points to the great geographical changes of Europe in comparatively recent times. The debris of existing glaciers is indicated on the slope from the Alpine summit clad in perpetual snow towards the great alluvial valleys of the Plain of Lombardy. The ancient representative of that Alpine glacier detritus is indicated by the uncoloured line of deposits from Snowdon over the coal-fields, the stipples indicating the lower boulder-clay, the sands and gravels, and the upper boulder-clay of some writers.

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GEOMANCY, (Greek, *gē*, the earth, and *manteia*,

divination) a kind of divination formerly practised. Sparry, in his translation of Cattan's Geomancie (written about the middle of the sixteenth century, and translated in 1591), says:—'Geomancie is a science and art which consisteth of points, prickes, and lines made instead of the foure elements, and of the starres and planets of heaven. . . . And thus every pricke signifieth a starre, and every line an element, and every figure the four quarters of the worlde, that is to say, the east, west, south, and north. Wherefore it is easy to know that geomancie is none other thing but astrologie, and a third mean, that is to say participating of two, which is alquemy. . . . And this arte may be made on the earth or on white paper, or uppon any other thing whereon it may commodiously be done, so that the prickes and lines may be knowen.'

GEOMETRY (Greek *ge*, earth, and *metron*, measure), as its name implies, is primarily the mathematical science which has for its object the measurement of portions of the earth's surface. According to the Greek historians geometry originated in Egypt from the necessity of measuring off portions of the land, or of readjusting the boundaries of landed property after the inundations of the Nile. Since that epoch its scope has been widely extended; the measurement of small detached portions of territory falls within the province of land-surveying, while the measurement of the surface of the globe, in a more extended sense, has become the object of geodesy. These two sections of the science have each their special importance, and present difficulties which have not failed in attracting the attention of eminent geometricians, such as Legendre and others; they may now, however, be considered but applications of the general science.

Geometry, according to the present meaning of the word, may be defined as the science whose object is the consideration of the relations of magnitude and of position or form of any conceivable portion of space. Thus the principal object of geometry is the study of the relations which must exist between the parts of the same definite figure, that is, constructed, or supposed constructed, according to a given law, and the comparison together of figures so constructed.

The relations between the parts of the same figure may be of two kinds,—of position or of magnitude; for example, two points are in a straight line, four points on the same circle; two straight lines are perpendicular to one another, a straight line is tangent to a circle or asymptote to a hyperbola, a circle is the osculating circle to an ellipse; those are relations of position. On the other hand, the proportionality of homologous lines of two similar figures, the equality of the square constructed on the hypothenuse of a right-angled triangle to the sum of the squares constructed on the sides containing the right angle, that of the rectangles constructed on the segments of two chords which cut each other in the interior of a circle, that of the volumes of two pyramids on equal bases of the same height, are relations of dimensions. But the relations of position govern the relations of dimensions, and *vice versa*; that is, the one set of relations depend upon the other. Thus it is because a triangle is rectangular that the square constructed on one of its sides is equivalent to the sum of the squares constructed on the other two, and, *vice versa*, that relation between the magnitudes of the squares on the three sides depends on the triangle being right angled. The geometer may draw indifferently from the study of a figure either the knowledge of the relations of position or that of the relations of dimension, on the condition that he knows how to apply relations of the one kind to those of the other: and the principal aim of geometry is to examine into the connection between the relations of magnitude and those of position. The investigation of these relations may, at first sight, appear very complicated, since the figures may vary *ad infinitum*; but in reality this difficulty does not present itself, because when figures are classified according to the laws on which their construction depends, the elements of the figures compared are always the same.

I. *Of Method in Geometry.*—The general problem of geometry admits of four distinct cases,—passing from one relation of position to another, passing from a relation of position to a relation of magnitude, passing from a relation of magnitude to one of position, and passing from one metrical relation to another. The second and third questions may be considered solvable without difficulty; the first and the fourth alone present each time fresh difficulties specially belonging to the proposed figure and to the nature of the desired transformation; it is in those two problems alone that art and a special skill become necessary to the geometer; we will therefore pass over the two others without remark. The fourth question is simpler than the first, as it is always more precise and more circumscribed; at least it is always approachable, since it is reducible definitively to eliminations. But, in addition to the investigation of the simpler means for effecting the eliminations presenting great difficulties, which art alone can overcome, at times the pure algebraic methods fail completely, and the geometer must adopt another method, as we shall soon see. The first question is the most difficult, as it admits of a greater indetermination.

Invention may result from investigations respecting questions of the first and fourth kind; but in the latter case the progress realized amounts, in most cases, just to having obtained the precise expressions of laws, the existence of which was foreseen, and of which the form was unknown. In the first, on the other hand, the gain consists in the discovery of new laws which might occasion the creation of new chapters in the science. For example, the theories of tangents, of asymptotes, of singular points, of osculating curves, &c., are related to questions of the fourth kind; the methods of transversals, of homology, of reciprocal polars, &c., sprung from speculations on questions of the first order.

Whether the geometer proposes to himself to pass from relations of position to other relations of position, or from relations of magnitude to others of the same kind, he has always the choice of two methods. In the first place he may try to attain his end by combinations of concrete ideas, interpreted by transformations of figures, or he may at once substitute for the given relations of position the relations of magnitude which they involve, then transform these relations of magnitude by algebraic processes, and return from the last metrical relations to the corresponding relations of position. In the second case he may limit himself to effecting, if possible, the definite algebraic transformations which will serve his purpose, or he may pass back from given relations of magnitude to corresponding relations of position, then transform these last relations in view of the object to be attained, and at last repass from the last observed relations of position to corresponding relations of magnitude. In other words, instead of keeping exclusively to the points which the very terms of the question display, the geometer may in every case substitute a question of the second kind for one of the first, and *vice versa*, and take as intermediate two questions of the second or of the third class which present no difficulty. In the first case a question of algebra is substituted for a question of geometry; in the second it is the reverse: a question of pure geometry is replaced by a question of analytic geometry, or the reverse. These trans-

formations, in constant use, are justified: in the first case the purpose is to substitute difficulties admitting of a methodical solution for others over which the operator would be powerless without inspiration; in the second, the intention is to substitute, if possible, for a tedious labour of elimination, ingenious combinations of concrete enunciations. It may be easily conceived that this last mode of transformation may present immense advantages, a very simple enunciation often taking the place of very complicated formulæ, and the bringing together of two similar enunciations might give rise to valuable views which algebra might not have evolved so easily.

II. *Divisions of Geometry.*—Geometry may be conveniently divided into six principal sections—elementary geometry, the geometry of mechanical curves, practical geometry, analytic geometry, infinitesimal geometry, and descriptive geometry.

Elementary geometry comprehends two parts—plane geometry, the object of which is the study of the simplest figures formed on a plane by straight lines and circles, and geometry of three dimensions, which treats of straight lines and planes considered in any relative position whatever, of figures terminated by planes, of the cylinder, of the cone, and of the sphere. Plane geometry is subdivided into two branches; in the first the study rests on the means of ascertaining the equality and inequality between two figures or of verifying the definite relations of position, and the end in view is the knowledge of the elements which may serve to define the figures and the means of constructing these figures. Thus, for example, we may study in this first part the conditions of equality of triangles, the conditions of perpendicularity or of parallelism of two straight lines, the conditions of contact between a circle and a straight line in order to construct a definite triangle on sufficient data, to draw a perpendicular from a given point, or a parallel to a given straight line, or a tangent to a given circle. The first part is concerned with the very existence of figures and the transformations to which their definitions can be subjected. The second part of plane geometry has for its object, on the one hand, the comparison of areas of polygonal surfaces with each other and with the area of a circle; and on the other the establishment of relations of magnitude corresponding to the simplest relations of position.

Geometry of three dimensions is likewise subdivided into two branches having the same objects as those which compose plane geometry, the only difference being in the nature of the figures.

It is of importance to remark that the elementary geometry of the moderns is distinguished from that of the ancients by two marked characteristics. On the one hand, while the Greek geometers could recognize the equality between the areas of two plane figures or between the volumes of two bodies taken from among those the study of which is comprised in the elements, never proposed to themselves to obtain anything analogous to that which we call the measurement of a surface or of a volume. Their geometry remained entirely theoretical, while ours trenches on the practical. On the other hand, they never evolved, from the ascertained simple relations between the surfaces and volumes which they had compared the more complicated relations which exist between the linear elements of these surfaces or volumes; the two things, however, have an intimate connection. We make this remark, because if it were not kept in view it would be impossible to account for the efforts which have been necessary to constitute analytical geometry.

Geometry of Curves.—The geometry of curves, which were called by the ancients mechanical, because they could only be constructed by the aid of instruments more or less complicated, has disappeared, being absorbed in analytical geometry. It comprehended specially the study by elementary processes of the principal properties of conic sections.

Analytical Geometry.—Though the curves studied by the ancients did not present themselves without a real order, since their invention sprang from felt wants, still no connection existed between these curves, nor was there any means of establishing one, so that the study of one was of no value to that of another. Indeed identity, even when it existed, might be far from established, for one curve a little complicated possessed an infinite number of totally different properties, admitted consequently of an infinite number of definitions the relation between which might be often very difficult to perceive. Analytic geometry arose from the necessity of introducing order and method into the investigations previously pursued without a settled plan and without sufficient preparation. The principles of this new geometry are so simple that a few words are all that is needed to explain them.

Every definition of a curve comprises in itself the indication of the processes to be followed in order to construct that curve by points, that is, to obtain successively points as numerous and as closely brought together as is necessary in order to lay down the curve. The process always consists in reproducing any number of times some definite figure the dimensions of which depend on an element variable at will. For each *value* of that element the figure takes a determinate form, and the prepared constructions always end in the determination of a particular point which is one of the points of the curve. When the variable element changes the point found changes also, and if it is supposed that that element increases continuously at the same time the corresponding point is continuously displaced, and describes the proposed curve. The principal inconvenience of ancient definitions of curves was that each definition of the curve, given from one of its many properties, led to a new moving or changing figure, such as has just been described. The mere verification of the identity of a curve defined in several different ways presented insurmountable obstacles; and finally, the theories of a curve naturally resulting from the study of the law of deformation of the various moving figures which could produce it were as numerous as the modes that could be conceived for its generation. The preliminary study, always laborious, of the moving figure had on each occasion to be recommenced. The first question in introducing the analytic method was then to fix upon some types, between which could then be chosen, according to the cases, the moving figures which should serve to construct every curve by points. Now, the position of a point on a plane depends on two elements, and giving one of these elements was giving a line on which the point should be found. Giving two elements which determine a point is then giving two lines which would intersect each other, that is to say, the figure to be constructed in order to obtain the point. That, however, is only one side of the question. The moving figure which generates a curve remaining always the same the law of deformation of that figure, that is to say, the mere definition of the curve, can be nothing else than a relation between the two elements, always the same, which determine each point. The curves will then be defined by equations, and the study of these curves will be simply the study of their equations. The two elements chosen to fix the position of a point are called the co-ordinates of that point. We may have an infinite number of systems of co-ordinates, but in each system the definitions of every curve are comparable, the study of these curves depends on

similar investigations, and can be prepared for beforehand by the preliminary establishment of general formulæ, furnishing completely calculated solutions of the principal simple problems, which by their various combinations form all the special questions which may have to be approached. That being granted, the method may be easily imagined. In the first place, a curve presenting itself under any definition whatsoever, if it is brought into relation with the adopted system of co-ordinates, and if in that first operation whatever is variable is left indeterminate, we shall have the most general equation for the curve in that system, that is to say, its typical equation, so that if at another time the curve is represented under another definition in investigating its equation in the same system of co-ordinates, particularized so as to simplify as much as possible the calculations, it will suffice to compare the particular equation with the general one to verify the identity of the curve, to give it its name, and to know all the properties of it which have been studied previously. Thus, in the first place, the identity of the same curve will always be easily recognizable, no matter what the definition may be. On the other hand, it will be easy to put into relation any two curves connected with the same system of co-ordinates. In fact, the most elementary relation between curves is the relation of intersection; now, the simultaneous representation of two curves in the same system of co-ordinates furnishes directly the means of finding the points where they meet. In fact, the co-ordinates of the points where two curves meet, satisfying at once both their equations, are found by the algebraic elimination between the equations. Thus the most general question which the study of curves will admit of is reduced to the most elementary analytical difficulty. The special study of solutions, furnished according to the various cases by the systems of equations for two curves, will, besides, render evident the more intimate connection which these two curves may have.

This being granted, it now remains for us to trace the path which has to be followed in the institution of the new geometry. We commence by establishing the formulæ of transformation necessary for changing the bases of the system of co-ordinates. These formulæ will admit of the recognition of the different forms which the equation of one curve might take if the bases of co-ordinates were altered, and consequently they aid in the choice on each occasion of those bases which will best suit the investigation we have in view, with which we shall arrive at the simplest form of the equation of each curve. As the straight line and the circle are destined on every occasion to be put in relation to the most complicated curves so as to throw the properties of those curves into relief, we must reconstruct in the system of co-ordinates adopted the complete theories of these two lines, that is to say, we must previously establish the formulæ of the solutions of all elementary problems which are connected with the straight line and circle. These preliminaries being completed, we pass to the special study of curves represented by the simplest equations. These curves, if the system of co-ordinates has been well chosen, will themselves be the simplest, and consequently the most usual, and thus the most useful to be known. All we have just said may be applied without difficulty to geometry of three dimensions, that is, the geometry of surfaces. Three elements are necessary for determining the position of a point in space; the co-ordinates of a point will thus be three in number; a surface will be represented by an equation between the three co-ordinates of one of its points, and a line will be represented by the system of two equations between the three co-ordinates.

Infinitesimal Geometry.—Under this denomination we comprehend the geometrical investigations which cannot be approached but by methods furnished by the infinitesimal calculus. This geometry is simply a continuation of the analytical geometry of Descartes, of which it may indeed be said it forms a part; the difference consists simply in the nature of the questions which are no longer within the exclusive province of elementary geometry, and of the theory of equations between finite magnitudes, but require the use of the infinitesimal calculus. The questions which it embraces are of two kinds—those which spring from the differential calculus, and are related to the contacts of various orders which may exist between two curves or two surfaces, and those which form the applications of the integral calculus, and have for object the measurement of magnitudes, the elements of which being incessantly variable cannot be summed by finite parts.

Descriptive Geometry.—This branch of general geometry does not, properly speaking, form part of the pure science. It is rather a particular art, of great value to practical geometers, but in theory of comparatively little importance. The principal aim of descriptive geometry makes up for the want of a picture or diagram in three dimensions by the association of two diagrams in two dimensions. These diagrams, usually formed in two planes at right angles to each other, receive the orthogonal projections of the points of space, and as the two projections of a point determines the position of that point in space, the descriptive mode of representation fulfils at once the two essential conditions for defining the object, and are only applicable to it. It is but proper to remark, however, that descriptive geometry fails, and necessarily fails, in means for directly representing the very objects of geometry of three dimensions, namely, surfaces. It is to the illustrious Monge that the science of descriptive geometry is due; for though engineers and architects must long have employed the method, imperfectly, no doubt, and perhaps unconsciously, and though in this sense the ancients were acquainted with it, yet it was reserved for Monge to lay down clearly the elementary principles of the science, and to compile a complete treatise on the subject.

III. *History of Geometry.*—We think it advisable to divide the history of this science into eleven periods, distinguished one from the other either by the changes which arose in the methods adopted, or by the nature of the investigations pursued. We shall, therefore, follow the chronological order, and as we proceed we will sketch successively and separately the history of all the branches of the science. The first period begins with Thales and ends with Plato; the second reaches from Plato's time to that of Euclid; the third carries us on to Hipparchus; the fourth to Menelaus and Ptolemy; the fifth to the extinction of the school of Alexandria; the sixth stretches from the revival of learning in Europe to Vieta; the seventh closes with Kepler; the eighth with Descartes; the ninth with Newton; the tenth with Monge, and the eleventh includes the geometers of the present day.

First Period.—The origin of geometry is lost in the mists of antiquity. The notions of perpendicularity and of parallelism; the conditions of the equality of triangles; the most elementary properties of the circle, relative to its diameters, to its chords and its tangents, and the primary notions of the sphere, must have been familiar to the Egyptians; but if Thales taught them, according to current belief, how to calculate the height of an obelisk by the length of its shadow, their knowledge of geometry did not reach farther than those intuitive notions

which are the mere result of attention. The history of the science, for us at least, must commence with Thales (639–548 B.C.) To that philosopher (born in Phœnicia, afterwards the founder of the Ionian school at Miletus) is attributed the remark which forms the basis of the theory of similarity of figures, that is, that the sides of equiangular triangles are proportional. It may well be believed that Thales had no precise ideas except on simple relations, being able to express himself only in whole numbers; but geometry itself furnished the means of arriving at more general notions in this respect. Immediately following him, in point of time, came Pythagoras (born about 580), who had been his disciple, and who founded his celebrated school in Italy, where geometry was as highly honoured as philosophy. The invention of the theorem of the square of the hypothenuse, for which the science is indebted to him, had probably been preceded by at least the study of the simple relations between the areas of triangles and of parallelograms, relations which, when the consideration of incommensurable ratios are put aside, are perceived almost intuitively. The discovery of the fundamental property of the right angled triangle completed, so to speak, the geometry of polygons. The theory of regular polygons took its rise at the same time in the same school, which probably got so far as the comparison of volumes of parallelopipeds, at least in the simpler cases, since the problem of the duplication of the cube had been stated.

Second Period.—Archytas, one of the successors of Pythagoras, from whom Plato received the first elements of geometry, forms the natural link between the first and second periods. Of the problem of the two proportional means, which Hippocrates of Chios, celebrated for his lunulæ, had related to the duplication of the cube, he gave a solution, more theoretical than practical, which rested on the consideration of the curve of intersection of a cylinder and of a torus. Plato and his disciples Menechmus and Eudoxus, gave solutions of the same problem, much more simple, by the intersections of conics or even of mechanical curves more complicated, and found the theory of geometrical *loci*, which in the Athenian school took the name of transcendent geometry; and the analytical method which Theon has thus defined: to regard the thing sought as the thing given, and to go from consequence to consequence until the thing sought is recognized as true; that is, to suppose the problem resolved, and infer, on the hypothesis that the imposed conditions are fulfilled, the consequences which result from it, in order to obtain in a practical form the relations of the figure which contains the data to that which comprises the unknown ones. Dinostratus, brother of Menechmus, imagined at the same time his celebrated quadratrix for the division of an angle into any number of parts proportional to given lines, and for squaring the circle. The results of the investigations of the geometers of Plato's school on conic sections were collected and arranged by Aristæus, in a work in five books, which was highly esteemed by the ancients, but which has not come down to us. Viviani has attempted to restore it from information derived from Pappus, under the title De locis solidis secunda divinatio geometrica in quinque libros injuria temporum amissos Aristæi senioris geometræ (Florence, 1701). We must also mention, as falling within this period, the works on elementary geometry written by Hippocrates of Chios, and by Leo, Theudius of Magnesia, Hermotimus of Colophon, Eudoxus, and Theætetus, which those of Euclid cast into oblivion, but which existed in the time of Proclus.

Third Period.—This period comprehends the names of the three greatest geometers of antiquity—Archimedes, Apollonius, and Euclid. Besides the geometry which we owe to the last-mentioned philosopher, we have from him: the Data, which form a sequel to the Elements, and designed to facilitate its use by the resolution of the problems. He has also left behind him four books on Conic Sections, two books on Loci which probably treated of the surfaces engendered by the revolutions of conics on their axes; and three books on Porisms. None of these last-mentioned works are extant. The Elements of Euclid are to this day a model of the form of demonstrations and the association of theorems. History records in this period, firstly, a complete theory of incommensurable relations, and secondly, the effective construction of roots of equations of the second degree. The theorem of the *lunulæ* of Hippocrates, establishing an exact connection between two surfaces, the one terminated by a curvilinear outline and the other by a rectilinear one, had raised sanguine hopes, from which sprang persevering investigations relative to the squaring of the circle. Of course the problem was insoluble, but the ignorance of that time as to the incomparability of incommensurables of different origins prevented them from perceiving the impossibility of obtaining a solution of the problem by means which they felt bound exclusively to employ. Investigations continued to be made in the same direction, without gain of ground, till Archimedes appeared. It is well known that that geometer solved the problem in the only shape in which it can be solved, and extended his method to the squaring and cubing of the cylinder, the cone, and the sphere. We may remark simply on this subject that Archimedes appears to be the first geometer of antiquity who caught a glimpse of the double signification as to proportionality and as to numerical equality of the formulæ which enunciate the theorems of geometry relative to the comparison of areas. Just as Euclid had said, 'Two rectangles have between them a compound ratio of the sides,' and not what was only said five or six centuries later: 'The measure of a rectangle is the product of the measures of its sides;' so Archimedes said: 'The circle is equal to the rectangle whose base is the half-circumference and whose height is the radius,' and not, 'The measure of the circle is the product of the measures of the half-circumference and the radius.' But without further innovating respecting the form to be given to the enunciations in the dogmatic exposition of the science, Archimedes well knew in these special cases how to interconnect the numerical values of the elements of the figures. It was thus he arrived at the approximate value $\frac{22}{7}$ of the relation of the circumference of a circle to the diameters. Half a century after, Aristarchus of Samos made another step in advance in this direction, in attempting to ascertain the relations of the distances of the sun and moon to the earth by the knowledge of the angle subtended at the earth by the distance between the sun and moon, seen when the angle at the moon is right in the triangle which has its angular points at the centres of the three spheres. Archimedes also devoted himself to numerical speculations, as may be seen from his Arenarius. The neighbourhood of the school of Pythagoras, with which it is to be supposed he must have had some communication, would perhaps explain this peculiarity in a geometer of that age. However that may be, to him can be traced back the invention of logarithms, which is clearly indicated in the book we have just mentioned. The other works of Archimedes on geometry treat of the squaring of the parabola and the cubing of the segments of the paraboloid, of the ellipsoid, and of the hyperboloid of revolution, problems incomparably more difficult than any previously attacked, and from

which might have sprung twenty centuries earlier than it did the infinitesimal analysis, had algebra been made independent of geometry.

Scarcely had Archimedes disappeared beneath the ruins of Syracuse when Apollonius arose in Alexandria and earned an almost equal renown in a different branch of the science. Archimedes had completed that branch, the object of which is the comparison with each other of magnitudes of the same nature; Apollonius made an analogous progress in that which treats specially of the properties of figures. His eight books of Conics, in which he considers these curves in the oblique cone, which had not been done until that time, contain almost all their interesting properties, those which relate to their foci, tangents, asymptotes, or diameters, and to their involutes. This great work, of which only the first seven books are extant, procured for its author the name of *The* Geometer. We have also from him De sectione rationis; of his other treatises, De sectione determinata, De tactionibus, De inclinationibus, and De locis planis, we have no knowledge except that derived from some notes in the commentaries of Pappus. Apollonius had been preceded several years by Eratosthenes, director of the library of Alexandria under the third Ptolemy, and who had left a highly esteemed work entitled De locis admetiatis, now lost; the only extant treatise of his being one on the duplication of the cube.

Fourth Period.—This period, which corresponds to the most brilliant era of astronomy, offers but a single discovery in the domain of geometry, yet one of immense importance, the discovery of trigonometry. None of the works of Hipparchus have been preserved, but the Almagest has revealed the numerous and extensive hints which Ptolemy has borrowed from them; and according to Delambre, whose testimony can scarcely be questioned on such a subject, it is to Hipparchus that are due almost all the methods of calculation adopted by the ancient astronomers. We may remark in a historical point of view that the trigonometry of Hipparchus is very far from corresponding with the methods afterwards applied by Vieta, for solving by algebra the determinate problems of geometry. Then it had only to do with a problem entirely special, as Hipparchus and Ptolemy only employed right-angled triangles, and as to the numerical calculation of chords of different arcs, it constituted only a more extended application of the method taught by Archimedes for the valuation of the approximate ratio of the circumference of a circle to the diameter. To Geminus, another geometer of this period, are attributed by Proclus two works no longer extant, one relating to the spiral, the other entitled Enarrationes geometricæ, which probably was a history of the science. Perseus, several years later in date than the preceding writer, wrote a work on the sections of the torus, which is also lost; Theodose has left, under the titles Sphæricorum libri tres, De habitationibus, and De diebus et noctibus, three elementary works on the sphere, the climate, and the inequality of days and nights, which have rather a closer connection with astronomy than geometry.

Fifth Period.—The geometrical science of this period was enriched by—1st, the celebrated theorem of Menelaus relative to the six segments determined on any transversal on the sides of a triangle, a theorem which was long attributed to Ptolemy. It formed in the Spherics of Menelaus the basis of the fundamental theorem of spherical trigonometry, and was reproduced for the same purpose by Ptolemy; it has since become in the hands of Carnot the starting-point of the beautiful theory of transversals; 2d, of the theorem which Guldinus laid claim to, and which has been found in the Mathematical Collections of Pappus; 3d, the theorem relative to the four segments of any transversal by four fixed straight lines issuing from the same point; this theory of the constancy of the ratio of the distance relations of points of intersection of the transversal with two of the four straight lines and point of intersection with the other two, has since become in the hands of Chasles the starting-point of a new theory of conics; 4th, the theorem relating to the six segments intercepted on a transversal by the four sides and the diagonals of any quadrilateral; 5th, the theorem to which the *hexayrammum mysticum* is reduced when the system of two straight lines is substituted for any conic; and 6th, the theorems which have, in the hands of Desargues, led to the theory of involution. All these theorems, which are perhaps due to Pappus, are very remarkable, and as we have just shown were called upon to play an important part in the domain of science. As belonging to this period we may further cite the identification of the sections of the cone and of the cylinder, by Serenus, the generation of the ellipse by the movement of a point of a straight line of always the same length, gliding between two fixed straight lines, conceived by Proclus; and the invention of the cissoid by Diocles, for the resolution of the problem of the two proportional means. But of these inventions, those of Pappus were almost premature, as at that time they served no end; and the others were simply additions of little value to the labours of the geometers of the two preceding periods. What makes this period remarkable is, perhaps, the work of Diophantus and of his disciples, more especially of Hero, the author of the oldest treatise on land-surveying. Diophantus has been regarded simply as an arithmetician or algebraist. We look upon him as the forerunner of Vieta, the inaugurator of the greatest revolution which has been produced in *method;* not that we ascribe true genius to that remarkable man, but because, without foreseeing it, and, doubtless, still more without intending it, he has powerfully contributed to establish the identity, now evident, but then little suspected, between the functions of geometric origin, the fourth proportional and the mean proportional, and the functions of arithmetical origin, the product or the quotient and the square root. It has not been sufficiently noted that the enunciations of the arithmetical and algebraic problems which Diophantus has treated are, so to speak, derived from the enunciations of the problems of geometry contained in the Elements of Euclid, and arranged almost in the same order. Diophantus was the model on which the Arabic algebraic geometers, Leonard of Pisa, Tartaglia, Cardan, and finally Vieta, at first formed themselves. He was thus the connecting link between the ancients and the moderns. It must be remarked, however, that though Diophantus may have had some sort of a presentiment of the revolution which was about to be accomplished, he by no means carried it to the final issue; that honour must be ascribed to Hero of Alexandria, whose treatise on land-surveying contains the rules for the measurement of the areas of polygons, and, above all, the formula for the area of a triangle as a function of its sides, a formula the mere existence of which proves that the revolution was achieved, and that algebra and geometry had now become definitively allied. We are not quite certain of the date that must be assigned to this Hero, who is called the Elder, to distinguish him from another Hero called the Younger, who also belonged to Alexandria. We believe he lived about the sixth century; Chasles places him in the second century before Christ, which is evidently a gross mistake.

Sixth Period.—This period extends from Hero to Vieta. After the sack of Alexandria and the burn-

ing of its library by Omar, the science sought refuge in India, or rather it confined itself to that country, for it existed there in the time of the Greeks. Brahma-Gupta followed Hero at an interval of about a century, and he is the first and most illustrious representative of the Indo-Arabic school. His works have only been known to the Europeans within these last few years. They were for a long time forgotten by the Hindus. On comparison with the old Arabic geometrical works, we discover that the latter have borrowed largely from them. Geometry is not treated of directly in them; what of it they do contain is disseminated in the chapters devoted to arithmetic and algebra; but it is precisely that association which forms their principal characteristic. In those remarkable works are found not only the formulæ for the area of the triangle, and for the radius of the circumscribed circle as a function of the three sides of the triangle, but also those (which appear there for the first time) of the area of a quadrilateral inscribed in a circle as a function of its four sides, of its diagonals, of the heights of the triangles of which it is composed, and of the diameter of the circumscribing circle.

Seventh Period.—This period is almost entirely represented by Vieta. The development of the methods of application of algebra to geometry was long and painful. Vieta crowned the work of fifteen centuries; but *tantæ molis erat*, that Vieta only succeeded in giving an uncouth form to the demonstrations of the elementary rules of algebraical calculation applied to the concrete magnitudes. His algebra was born and died with him. It was to Descartes that the honour of putting the finishing touches to the work was reserved. He did so in a few lines in the opening pages of his geometry. To Vieta geometry owes many improvements; he simplified trigonometry considerably, and to him are due the majority of the elegant formulæ which now constitute it. It was he who first resolved the problem of the three spherical triangles where the three sides are given; this problem, never presenting itself in the practice of astronomy, had been neglected by the Arabic philosophers. He explained the multiplicity of the solutions of the problems of trigonometry, and connected with the trisection of the triangle or the duplication of the cubes all the cases of the equation of the third degree, which, in the Ars Magna of Cardan, rose to an immense number. He constructed also the roots of the equation of the fourth degree, and gave the first geometrical solution of the problem of the circle tangent to three others. And, to conclude, it is to him we owe the treatise De tactionibus, which he restored under the title of Apollonius Gallus.

Eighth Period.—This period comprehends three great names, those of Kepler, Galileo, and Cavalieri. The undying renown of Kepler and Galileo has been acquired by the former chiefly in speculative astronomy, and by the latter in physical astronomy, in physics, and in dynamics. Yet the labours of Kepler in the regions of pure geometry have been of some importance. His Stereometria doliorum (solid-measurement of jars), a strange enough title certainly, contains the first applications among the moderns of the method of Exhaustions of Archimedes, freed from the difficulties which had encumbered the geometry of the Greeks. Kepler found by this method the volumes engendered by the revolution of a conic round a straight line parallel to one of its axes. We must also remark that his method for graphically representing the circumstances of an eclipse have a striking similarity to the processes of descriptive geometry. Galileo is only known as a geometer from his invention of the cycloid. The supremacy in this period belongs to Cavalieri, whose method for quadratures and cubatures, published in 1635 under the title Geometria indivisibilibus continuorum nova quadam ratione promota, is entirely new. The Exercitationes geometricæ, which appeared in 1647, contain the demonstration of the famous theorem of Guldin and the solution of the problems which Kepler could not solve.

Ninth Period.—In the period filled up by the immortal labours of Descartes, Fermat, Roberval, Desargues, Pascal, Huyghens, Wallis, and Barrow, analytical geometry arose, and the era of modern geometry opens. The methods of tangents and of maximums of Fermat and Barrow, and the theory of involutes of Huyghens, which point to the discovery at a close date of the differential calculus, the processes for summation of Roberval, Pascal, and Wallis, which point in the same way to the integral calculus; and the descriptive inventions of Desargues, which bring us more closely to the present epoch. This period in the history of geometry may at least be compared with that of Archimedes, Apollonius, and Euclid. We need not again here refer to the labours of Descartes, but simply mention the analytical method which he has given for tangents in his Géométrie, and his geometrical method for the same problem relatively to the cycloid, and more generally to every epicycloid, a method which has since become the foundation of the theory of the instantaneous centre of rotation. The theory of involutes of Huyghens was a fresh step towards the infinitesimal calculus. He was led to treat of it in connection with his researches in mechanics; thus it is found inserted in his great work on the pendulum, De horologio oscillatorio. Huyghens employed it specially in the solution of the problem of the cycloidal pendulum.

Tenth Period.—This period, which extends from Newton to Monge, is certainly the most brilliant of all in the general history of mathematics; it occupies, however, but a secondary rank in that of geometry. The principal gains to the science were the method of isoperimeters of the brothers Bernouilli, the theorem of Newton on the generation of curves of the third order, and the remarkable theorem of Maclaurin on the attraction of an ellipsoid, the theory of curves of double curvatures of Clairaut, and the theory of the curvatures of surfaces of Euler.

Eleventh or Present Period.—This period, which commences with Monge, is one of the most brilliant in the whole history of the science. The other two principal names which inaugurate the period are those of Carnot and Poncelet. The beginning of it is characterized by an innovation, the boldness of which would have appalled the two preceding generations, the introduction of imaginary quantities into geometry, the realization of these symbols, and their adaptation to practical uses. The remainder of it down to the present day has not been long enough to exhaust the treasures discovered through its introduction. In fact, instead of exhausting them, we have seen the whole science revolutionized by the improvements in power that the use of imaginaries has given. Progress in this new order of ideas has been made through well marked stages. Monge, without ever thinking of realizing the *imaginaries*, introduced into analytical geometry the fertile principle of contingent relations. Carnot, who appears to have closely attacked the problem of the construction of imaginary solutions, failed completely; but the luminous philosophical appreciation which he had made in his Géométrie de Position of the method of interpretation of negative solutions, fixed pretty clearly the terms of the question, and plainly indicated the path to be followed in order to reach a speedy solution of this question. Besides, the putting

of the question was a great step; it freed the intellect from an inveterate superstition. General Poncelet, more timid than Carnot in his way of putting the question, solved it, though scarcely avowing it to himself, and hardly daring to employ it in the problems which are constructed by the intersection of curves of the second degree. At last, M. Marie, embracing it in its widest generality, gave the definitive solution of it. Carnot's first contribution to geometrical science was his principle of the *correlation of figures*, a principle which, having been farther generalized, is now known as the *principle of continuity*. His second contribution was his *theory of transversals*. On these inventions is founded *modern geometry*, which has revolutionized the science, and has given us generalized conceptions previously undreamed of. It is impossible for us to give an account of the late progress of geometry; we cannot even enumerate the very numerous discoveries of the 19th century. In Germany, in Italy, and in France, labourers have gathered rich results, but it is at home that the greatest accessions have been made. The Dublin mathematical school deserves the first mention. Founded by the illustrious MacCullagh, whose brief career was yet long enough to enable him to leave the impress of a master mind upon his disciples, it has taken a place second to none. The admirable writings of Salmon and others would alone have made it famous, but the labours of Sir William Rowan Hamilton have pre-eminently distinguished it. To him is due the invention of Quaternions, an entirely new method in geometry. So short is the time since the invention of this wonderful method that we may safely say that it is impossible to foresee to what great results it may lead. Already it has proved fruitful in the fields of optics, dynamics, and astronomy. In another and very different direction the labours of Cayley and Sylvester have made the present age famous in the history of geometry. They have advanced into regions previously unthought of, and have applied generalized geometrical methods to space of more dimensions than three. To such speculations the want of a practical application may be raised as an objection. Hitherto, as far as physical science is concerned, they have, necessarily from their nature, been barren. The importance, however, of the generalization of geometrical methods cannot be denied.

GEORGE, Duke of Saxony (*the Bearded*), born in 1471, was the son of Albert the Brave, the founder of the Albertine line of Saxony, and Zedena of Bohemia. He was at first intended for the church, and in 1484 was received as a canon into the chapter of Meissen. He early developed a warm feeling for learning, which was not without influence on his government. On the death of his father in 1500 he succeeded to the whole of the hereditary dominions of the Albertine house, while his younger brother Henry, in accordance with the agreement concluded between the father and the two sons in the previous year at Maastricht, obtained the recently-acquired Friesland. Subsequently Henry gave up Friesland to his brother in exchange for Freiberg and Wolkenstein and a year's revenue, and ultimately George was glad to hand it over in 1514 to the house of Austria. Soon after this he became involved in the turmoils of the Reformation period. He has often been represented as one of the most unyielding enemies of this movement; but the investigations of modern historians have shown that he was from the first by no means disinclined to the efforts after reform in the church. He fully recognized the extent of the corruption that had crept into it; but through his correspondence with Erasmus he had been led to the conclusion that it might be checked by strict observance of the Papal edicts, and by means of a council summoned by the pope. In the Leipzig controversy he had shown himself to be not unfavourable to the aims of Luther; but the latter so provoked him by his letters and other writings that he became always more and more prejudiced against the uncalled for steps which he considered Luther to have taken, and was led to lay the blame of all the religious and political extravagances of the time upon the Reformation, which he endeavoured to suppress by violent measures. These, however, were unsuccessful, and when his brother Henry, who was a Protestant, succeeded him on his death in 1539, the Reformation was introduced into the dominions of the Albertine house of Saxony under the protection of the reigning duke. His later years were saddened by the successive deaths of his wife (after which event he allowed his beard to grow, whence his surname) and eight children.

GEORGE, Lake, called also *Horicon*, a lake in New York, between Warren and Washington counties, south of Lake Champlain, with which it communicates. It is romantically situated but a short journey from Saratoga Springs, from which an excursion to the lake is considered a matter of course. It varies from ¾ mile to 4 miles in width. The whole length is 36 miles. The waters are discharged into Lake Champlain at Ticonderoga by an outlet which in the course of 2 miles sinks 180 feet. The best view of the lake and its environs is from the southern extremity near the remains of old Fort George, whence the prospect embraces the village of Caldwell, with numerous small islands. The calm waters of the lake are seen beautifully contrasted with the parallel ridges of craggy mountains through an extent of nearly 14 miles. Near the southern shore are the ruins of an old fortification called Fort William Henry, taken by the Marquis de Montcalm in 1757 with its garrison of 3000 men, nearly all of whom were massacred by the Indian auxiliaries of the French. From this spot General Abercromby embarked in 1758 with an army of 15,000 men for an attack on Ticonderoga.

GEORGE, Order of St. The following are the principal of the numerous orders which have been founded in honour of St. George:—1. A military order instituted in Russia in 1769 by the Empress Catharine II. as a reward of military achievements. The decoration is a golden cross with four branches, having a shield in the centre representing St. George slaying a dragon. 2. An order instituted in Bavaria in the twelfth century, and reinstituted by the Emperor Charles VII. (Charles Albert) in 1729. 3. An order instituted by Ernest Augustus of Hanover on the 1st of January, 1840. 4. An order instituted by Frederick III. in 1468 for the defence of Hungary and Bohemia against the Turks. It became extinct about the end of the sixteenth century. An order of the same name is said to have been previously instituted about the end of the thirteenth century by the Emperor Rudolph of Hapsburg. 5. The order of St. George is the name under which the order of the Garter was first instituted in England. See Garter (Order of the).

GEORGE, St., 'the holy knight,' patron saint of England. He was canonized in 494 or 496 by Pope Gelasius at the same time that his Acts (*gesta*) were declared to be apocryphal. According to one of the numerous legends referring to him he is represented as a prince of Cappadocia who was martyred by Diocletian, and who had sustained long contests against a magician called Athanasius in the presence of a Queen Alexandra. According to another he delivered on the borders of a lake as large as a sea a lady who seemed about to become the prey of a

dreadful monster. Ancient Greek paintings represent him as piercing this monster (a dragon or a crocodile) with his lance, and as mounted on a winged horse, a circumstance which seems to be a reminiscence of the mythological Perseus. The heroic character of the traditions ascribed to this personage struck the imagination of the Crusaders, who adopted him as one of their patrons, and introduced his worship into the West. Gibbon has identified this legendary saint with the infamous parasite, extortioner, and heretic (Arian), George of Cappadocia, who was placed in 354 in the see of Alexandria by the Arian Council of Antioch, which had previously expelled the venerable Athanasius, and who was slain in 361 in a rising of the populace who had been infuriated by his oppression and his violence against pagans and orthodox. If this identification is correct, it would appear that in the first of the legends above mentioned these historical events are found under a mythical disguise. It would then be Athanasius, the orthodox bishop of Alexandria, who reappears as the magician Athanasius of the legend, and the see which formed the subject of the contest between the two would be the original of the Queen Alexandra. This identification has, however, been objected to by many eminent scholars, Protestant as well as Roman Catholic, chiefly by Papebroche, Heylin, and Bishop Milner, with regard to the tract written on the subject by the last of whom Dean Milman says, in a note to the passage of Gibbon referring to George of Cappadocia, that in his opinion Bishop Milner 'succeeds in tracing the worship of St. George up to a period which makes it improbable that so notorious an Arian could be palmed on the Catholic Church as a saint and a martyr.' He adds that 'the Acts rejected by Gelasius may have been of Arian origin, and designed to ingraft the story of their hero on the obscure adventures of some earlier saint.' But whatever may have been the true history of this saint, whether he is entirely legendary or to be identified with George of Cappadocia, or some other unknown historical personage, his worship spread rapidly in the West after its introduction by the Crusaders. He was adopted by the Genoese as their patron saint, and in 1222 the Council of Oxford ordered that his day (the 23d of April) should be observed as a national holiday in England. In 1344 an order was instituted in his honour by Edward III., and in 1350 this order was made the order of the Garter, of which accordingly St. George is the patron.

GEORGE, St., one of the Bermudas, lat. 32° 45′ N.; lon. 63° 30′ W. It is about 3 miles long and half a mile broad, and commands the entrance of the only passage for large vessels – the narrow and intricate channel being defended by strong batteries. It is the principal military depôt in the group.

GEORGE I. (George Louis), King of Great Britain, and Elector of Hanover, was the son of the Elector Ernest Augustus, by Sophia, daughter of Frederick, elector palatine, and grand-daughter to James I. He was born March 28, 1660, and was early trained to arms under his father. In 1682 he married his cousin, Sophia Dorothea, daughter of the Duke of Celle. The union was not a happy one. George I. was both a faithless and a jealous husband, and when his wife, who was guilty of some imprudences, brought on herself the suspicion of carrying on an illicit intrigue with Count Königsmark, he caused her to be imprisoned, and kept her in confinement for the rest of her life. The offspring of the marriage were George, Prince of Wales, afterwards George II., and Sophia, the mother of Frederick the Great. In 1698 he succeeded to the electorate, and in this succession was joined in the alliance against France The command of the imperial army was conferred upon him in 1707, but owing to jealousies among his confederates he resigned the command at the end of three campaigns. At the Peace of Rastadt Louis XIV. recognized the electoral dignity in the house of Lunenburg, as he had already by the Treaty of Utrecht recognized the succession of the same house to the throne of Great Britain, which event took place on the death of Anne in 1714, when the elector was in the fifty-fifth year of his age. His reign in England was disturbed first by a rising of the Scottish Jacobites in favour of the son of James II., and afterwards by wars with Spain, undertaken first in conjunction with Holland and France (the Triple Alliance of 1717), afterwards in addition with Austria (the Quadruple Alliance of 1718), with the view of checking the schemes of the Spanish minister Alberoni. The most celebrated minister of his reign was Sir Robert Walpole. George I. died at Osnabrück in 1727. (See Britain—History.) George I. was plain and simple in his taste and appearance; he possessed much natural prudence and good sense, and his management of his German dominions, to which he showed more attachment than to his English dominions, was able.

GEORGE II. (*George Augustus*), King of Great Britain, son of George I., was born 1683. He married in 1705 Wilhelmina Carolina of Brandenburg-Anspach. In 1708, then only electoral prince of Hanover, he distinguished himself under the command of Marlborough. He came to England with his father at the accession of the latter, and was created Prince of Wales. He was made regent during the king's visit to the Continent in 1716, but a political difference ensuing, he lived some time estranged from the court. This breach was finally accommodated, and in 1727 he succeeded to the throne. He inherited in full force the predilection of George I. for Germany; and the same system of politics and the same ministers continued to govern the nation after his accession as before it. In the earlier part of his reign, during the greater part of the ministry of Walpole, the neutrality of England was preserved during the wars on the Continent. In 1739 the depredations committed by the Spaniards in America on the commerce of England led to war, which brought about the resignation of Walpole in 1742. England next took part in the war of the Austrian Succession, in which George II. himself shared, being present at the battle of Dettingen, in 1743. His reign is also memorable on account of the second Jacobite rising in Scotland in 1745–46, headed by Prince Charles Edward. In 1755 the disputes between Great Britain and France in relation to their respective boundaries in Canada produced hostilities in that country, and an open war between the two nations the following year. The events of this war, in which the principal powers of Europe became engaged, raised Great Britain, under the able auspices of Pitt (first earl of Chatham), to the pinnacle of power. In this state of affairs George II. died suddenly, October 25, 1760, in the seventy-seventh year of his age and thirty-third of his reign. George II. was a prince of very moderate abilities, parsimonious, and wholly regardless of science or literature; hasty and obstinate, but honest and open in his disposition. His queen, the cultivated and well-informed Caroline, acquired a great ascendency over him, which did not, however, prevent some of the irregular attachments so common with royalty. See Britain—History, Walpole, Charles Edward, and Chatham.

GEORGE III., King of Great Britain, born in 1738, was the eldest son of Frederick, prince of Wales, by the Princess Augusta of Saxe-Gotha. On the death of his father in 1751, his education was

intrusted to the Earl of Harcourt and the Bishop of Norwich; but the formation of his opinions and character seems to have been materially influenced by the maternal ascendency of the princess dowager, who was principally guided by the counsels of the Earl of Bute. George III., who had been previously created Prince of Wales, ascended the throne on the demise of his grandfather, George II., October 25, 1760, being then in his twenty-third year. In the following year he married the Princess Charlotte Sophia of Mecklenburg-Strelitz, a union which in its result operated materially on the domestic character of this reign. In 1763 the Seven Years' war was concluded by the Peace of Paris under the ministry of Lord Bute (Pitt having retired from office in 1761). In 1764 Mr. George Grenville, who had become premier by the retirement of the Earl of Bute, began those measures in relation to the American colonies, the consequences of which proved so momentous; and the stamp act was passed the following year. About the same time, in consequence of some appearances of the mental derangement of the king, a bill was passed to enable his majesty to appoint the queen, or any of the royal family residing in England, guardian to his successor, and regent of the kingdom. In 1766 the Rockingham administration repealed the American stamp act; at the same time passing a declaratory act asserting the right of taxing the colonies. The Rockingham cabinet was dissolved July 30, 1766, and succeeded by one formed by Pitt, now earl of Chatham. In 1768 Lord Chatham, disgusted with the conduct of his colleagues, resigned the privy-seal, and was succeeded by Lord Bristol. The same year was distinguished by the return of John Wilkes for Middlesex, and the popular tumults attendant upon his imprisonment and outlawry. (See WILKES.) In the year following (1769), the letters of Junius, which caused a great sensation at the time, and have been the cause of much controversy since, began to appear. In 1773 the discontents in America burst into an open flame, and a royal message, in the commencement of the session of 1774, called on Parliament to maintain the supremacy of the mother country. (See UNITED STATES.) Notwithstanding the disastrous American war, and the loss of an empire, George III., by the steadiness with which he put down the coalition administration, acquired a degree of popularity which never afterwards entirely deserted him. The smooth course of the early years of the administration of Pitt materially added to this disposition, which exhibited itself very strongly when the constitutional malady of the king again displayed itself in 1789, and still more upon his subsequent recovery. In reference to the French revolution, and the important contests which arose out of it, it is sufficient to remark that George III. zealously coincided in the policy adopted by his administration. A similar observation will apply to the domestic, and Irish and Indian policy of the Pitt cabinet; as also to the transactions connected with the Irish rebellion. George III. was immovable in his opposition to the demands of the Irish Catholics, and, seconded by the influence of the church and the popular feeling, was enabled to eject the Fox and Grenville administration, which succeeded on the death of Pitt. The proceedings of the Perceval administration, until the final retirement of the king in 1810, need not be detailed here; while the insanity of the monarch renders the interval which elapsed from his retirement to his death a blank in his biography. His decease took place January 29, 1820, in the eighty-second year of his age and fifty-ninth of his reign. George III. possessed personal courage and steadiness of character in a high degree. Of a plain, sound, but not enlarged understanding, he acted upon his convictions with sincerity. His tastes and amusements were plain and practical. Literature and the fine arts engrossed but a small share of his attention, and hunting, agriculture, mechanical contrivances, and domestic intercourse, seem to have chiefly occupied his leisure. Religious, moral, and temperate, the decorum of his private life was always exemplary. His deportment as a father and a husband, according strictly with the national notions of propriety, rendered him and the queen a constant theme of praise; and the throne was regarded as a pattern in respect to the conjugal duties.

GEORGE IV. (*George Augustus Frederick*), King of England, son of George III. and the Princess Charlotte of Mecklenburg-Strelitz, born in 1762, died June 25, 1830. His dissipated life, his extravagance, his supposed marriage with a Catholic, Mrs. Fitzherbert, and his connection with the most prominent members of the opposition, alienated from him the affection of his father and the esteem of the nation. In 1795 he consented, on condition of the payment of his debts, to marry the Princess Caroline of Brunswick, but he soon began to treat her with neglect, and after the birth of their daughter, Charlotte Augusta, abandoned her. (See CAROLINE AMELIA ELIZABETH.) On the 3d of February, 1811, he was appointed regent, with limited powers, on account of the king being attacked the previous year by a repetition of the mental malady to which he was subject. The Whigs, his former friends, now hoped to come into office, but the prince showed a sudden change of sentiments, and maintained the Perceval ministry in power. The distress caused by the interruption of the demand for manufactures, and the high price of the means of subsistence after the general peace of 1815, occasioned great discontent among the people, and the violent measures adopted by the government increased the unpopularity of the regent, upon whose life an attempt was made in 1817 when he was going to open the session of Parliament. In 1820 he became king, on the death of George III. In February, 1827, Canning became head of the government. The most important event after his attaining the throne was the passing of the Catholic Emancipation Act, by the Wellington ministry, in 1829. George IV. left no descendants, his only daughter, the Princess Charlotte, wife of Leopold of Saxe-Coburg, having died childless in 1817. He was therefore succeeded by his brother, William, duke of Clarence (William IV.) See BRITAIN.

GEORGE-NOBLE, an ancient English coin, of the size of a double ducat, which was coined under Henry VIII., in 1540. The name is from the holy knight St. George, whose image is coined on it. The gold is of twenty-two carats.

GEORGE'S CHANNEL, St., the south portion of that arm of the Atlantic which separates Ireland from Great Britain, the south limit of which may be defined by a line drawn diagonally from Cape Clear in Ireland to the Land's End in Cornwall, a distance of about 200 miles. Northwards it blends with the Irish Sea, but may be said to terminate in this direction with the parallel of 53° 30′ N.; or with a line drawn from Dublin to Holyhead, a distance of about 65 miles. Its whole length, south-west to north-east, will thus be about 210 miles. The great tidal wave from the Atlantic enters this channel nearly simultaneously with its entrance into the English Channel, and thus brings high water about the same time to Brest in France, Falmouth in England, and Cape Clear in Ireland.

GEORGETOWN, a city and port of entry in the United States, in the district of Columbia, on the left bank of the Potomac, just above Washing-

ton. It contains the Georgetown College (the oldest R. Catholic college in the United States), the Peabody Library, &c.; and there are lumber yards, tanneries, and mills. The Chesapeake and Ohio Canal commences here. The Potomac is here crossed by the splendid aqueduct of the Chesapeake and Ohio Canal. Georgetown now ranks as part of Washington.

GEORGETOWN, or DEMERARA (Dutch, *Stabroek*), the capital of British Guiana, at the mouth of the Demerara. It has much the appearance of a Dutch town, consisting of broad streets at right angles, with canals in the middle and numerous bridges over them, and lofty wooden houses raised 3 or 4 feet above the ground on posts, and often with luxuriant gardens attached. Water Street, fronting the river, is occupied almost exclusively by European merchants, whose warehouses and wharves jut out into the stream. The principal buildings are the Episcopal Cathedral, Scotch, Roman Catholic, and other churches; the town-hall with the government offices, Queen's College, a museum and library, the colonial hospital, mariners' hospital, a lunatic asylum, two theatres, and there is also a botanical garden. There is a railway of 20 miles to Mahaica on the coast. At the mouth of the river is Fort Frederick-William; connected with it are excellent barracks and military hospital, and near it is a fine lighthouse. Georgetown, though in a low and swampy position, is moderately healthy; the annual death-rate being about 30 per 1000. There is a good harbour, but at the river mouth is a bar, on which there is only 15 feet of water; chief exports—sugar, rum, and coffee. Pop. in 1881, 47,175; in 1891, 53,176, of whom only about one-seventh are white.

GEORGIA (so called originally by the Byzantines, possibly from St. George, the patron saint of the land; by the Persians called *Gurjistan*, that is, land of the Kur or Cyrus; by the Russians *Grusia*, a corruption of the Persian name; by the ancients *Iberia*, and by the natives of the present day *Kartlli*), a region in Asia, situated near the centre of the Russian possessions on the south side of the Caucasian range, and now included in the Russian government of Tiflis. It is bounded north by the Caucasus; east by the province of Shirvan; south by an Armenian range, which separates the basin of the Kur from that of the Aras; and west by a branch of the Caucasus, forming part of the watershed between the Caspian and the Black Seas. The name is sometimes employed to designate a much larger but somewhat ill-defined portion of the territory possessed by the Russians south of the Caucasus, having an area of about 34,000 square miles; but when more correctly confined to Georgia proper the area does not go beyond 14,800 square miles. The surface is generally mountainous; mountain-ranges, as already described, surrounding it on the north-west and east, and sending out numerous ramifications; but the central part of it is occupied by a large and fertile valley, in which the Kur flows from west to east, and receives almost all its drainage. The soil, generally in the lower grounds, and more especially in this valley, is of great fertility, and having the advantage of a delightful climate, grows in abundance not only all the ordinary cereals, and maize, hemp, and flax, but great quantities of wine and cotton, and unlimited supplies of the most exquisite fruit. The culture, however, is very imperfect; and though important improvements have taken place since the Russians acquired possession of the country from Persia, it has not yet recovered from the disasters brought upon it by ages of misrule and almost incessant warfare. The natives, forming about three-fourths of the whole population, have been as much celebrated as the Circassians for the athletic frames of the men and the beauty of the women. These properties have created a large demand for both sexes—the males to serve in the armies, and the females to become inmates of the harems of the Turks. The nobles long derived their chief revenue from this inhuman traffic, valuing their serfs only for the money which they could obtain for them in the Turkish markets. It is said that great numbers of the celebrated Mamelukes were Georgians. Under the Russian sovereignty this traffic has ceased; and the distinction which divided the whole population into the classes of nobles and serfs, nearly equivalent to those of masters and slaves, though still subsisting, has been greatly modified. The power of life and death, which the nobles claimed, and made no scruple of exercising, has been expressly abolished, The Georgians belong nominally to the Greek Church, but both clergy and people are generally ignorant.

The language of the Georgians, which is harsh, but regular and nervous and possesses a peculiar structure, does not belong to the Indo-Germanic family of tongues It possesses a not unimportant literature, which begins with the introduction of Christianity into the country, and consists for the most part of ecclesiastical writings, and of translations from the Bible, from the fathers, from Plato and Aristotle, as well as their commentators. Profane literature flourished especially in the seventeenth century, and contains a good deal of poetry. Historical works are tolerably numerous, but those of a scientific nature are very limited, though recently, under the Russian government, science and education generally have begun to make considerable progress. Many works belonging to various branches of literature and science (including plays of Shakspere) have been translated from foreign tongues; and works of poetry and fiction have been produced by native writers.

The early traditions of the Georgians, who trace back their descent to Thargamos, a great-grandson of Japhet, are full of fable. Their history first becomes credible toward the time of Alexander the Great, to whom they became subject. About 324 B.C. they threw off the foreign yoke and became an independent kingdom under Pharnavas. Towards the end of the fourth century Christianity was introduced and supplanted the old religion, which was probably that of the Persian Mithra. It thus became connected with the Eastern or Greek Empire. Georgia was ultimately included in the dominions of the Arabian caliphs, though its native kings found refuge and a kind of independence in the more mountainous districts They first regained complete freedom towards the end of the tenth century, and retained it till the Mongolian ascendency was established in the thirteenth century. It was during these three centuries that the Georgian monarchy reached its highest prosperity. Towards the end of the fourteenth century Georgia fell into the hands of Tamerlane. In the end of the sixteenth century it began to enter into friendly relations with Russia. These were gradually drawn closer, and at last, in 1799, Heraclius, successor of George XI., formally ceded his dominions to the Russian emperor Paul. In 1802 Georgia was declared a Russian province It is now included with the other Transcaucasian possessions of Russia in one general government. See Brosset, Histoire de la Georgie (two vols., St. Petersburg, 1850-59); Villeneuve, La Georgie (Paris, 1871); and Wardrop, The Kingdom of Georgia (1888).

GEORGIA, one of the Southern United States of North America, bounded N. by Tennessee and North Carolina, E. by South Carolina and the Atlantic, S. by Florida, and W. by Alabama; length, north to south, 320 miles; breadth, 255 miles; area, 59,475 square miles. The coast is bordered by a chain of

islands, the principal of which are Tybee, Ossabaw, St. Catherine's, Sapelo, St. Simon's, and Cumberland; consisting of salt marsh and of a rich gray soil, on which the famous sea-island cotton is raised; and separated from each other by rivers, creeks, and inlets, forming a navigable communication capable of admitting vessels of 100 tons. The surface of the mainland is low and level for 50 or 60 miles inland, the first 4 or 5 miles from the coast being occupied by a salt marsh, succeeded by a belt of land similar to that of the islands. Beyond that commence the pine barrens, extending from 60 to about 90 miles from the coast, and interspersed with numerous inland swamps on the margin of the creeks and rivers, which are partially or totally overflowed by the return of the tide, and constitute the rice plantations. Beyond this region commences the country of sand-hills, 30 or 40 miles wide, interspersed with fertile tracts, and extending to the lower falls of the rivers; beyond which is the tract called the Upper Country, having generally a strong and fertile soil. In the north and west the surface rises into the Appalachian mountain chain, which here reaches in some places 1500 feet high. With the exception of some streams in the northern part of the state, which flow west into Alabama, all the rivers of Georgia flow in a southerly or south-easterly direction, but chiefly the latter. The principal rivers are the Chattahoochee, which also forms the greater part of the western boundary, and flows, under the name of the Appalachicola, into the Gulf of Mexico, and is navigable for steamers for 300 miles; the Savannah, navigable for steamers part of the year for 250 miles; and the Altamaha and its affluents, navigable for vessels of 30 tons 300 miles up from the Atlantic, into which both it and the Savannah fall. The climate is generally mild, and snow is of extremely rare occurrence; but in the low country it is unhealthy in July, August, and September. Cotton and rice are the staple productions; but tobacco, Indian-corn, wheat, and other cereals are cultivated with success; as are also oranges, melons, figs, grapes, pine-apples, peaches, bananas, and many other fruits. Georgia is very rich in good marble, and in the north, iron ores are abundant. The other minerals include coal (in the north-west), building-stone, slate, gold, fire-clay, &c. There are numbers of tanneries, flour-mills, distilleries, and the lumber trade has become important. There are also many cotton and woollen mills throughout the state, while the manufactures of iron and steel become every year of greater importance. The shad-fishery and the raising of oysters are also important industries. Cotton — raw and manufactured, — lumber, and naval stores are the principal articles of export, and the imports consist chiefly of manufactured goods. Atlanta is the seat of the legislature. Savannah is the chief seaport, and the other principal towns are Augusta, Macon, Columbus, Athens, and Brunswick. Education is provided by the University of Georgia, and by a great number of academies and primary schools. Of the religious denominations, the Baptists, Methodists, and Presbyterians are the most numerous. According to the present constitution, which was adopted in 1798, and amended in 1839 and 1868, the governor is elected by the people, and remains in office four years; the Senate consists of 44 members, and the House of Representatives of 168. The state has nine members in the national House of Representatives, and eleven electoral votes for President of the United States.

A charter for the foundation of a colony in the territory now called Georgia was obtained in 1732 by General Oglethorpe from George II., after whom the state was named, and the first settlement was made in the year following. It suffered much in the early periods of its settlement from wars with the Spaniards in Florida. It was taken by the British in the revolutionary war of 1778, and evacuated in 1782. In convention it adopted the constitution of the United States by a unanimous vote in 1788. In 1826 it was abandoned by the Creek Indians, and in 1838 the Cherokee Indians were removed by order of the United States government to the Indian territory, and Georgia then came into possession of some of the finest land in the state. In January, 1861, Georgia joined the Confederate cause against the Federal government by an act of secession passed by a convention called for the purpose. It was conquered by the Federal army under General Sherman in 1864–65, and was re-admitted to the Union in 1868. The population in 1880 was 1,542,180; in 1890, 1,837,353; in 1900, 2,216,329.

GEORGIA, GULF OF, a large inlet of the North Pacific Ocean, between the continent of North America and Vancouver's Island; about 120 miles in length from north to south; the breadth varies greatly in its different parts, from 6 miles to 20. It contains several clusters of islands, and branches off into a great number of creeks. It communicates with the ocean on the north by Queen Charlotte's Sound, and on the south by the Strait of Juan de Fuca.

GEORGIA, SOUTH, an island in the South Atlantic, lat. (north point), 53° 57′ S.; lon. 38° 13′ W. It is 90 miles long, and has high and rocky coasts, and a mountainous interior, with valleys between the ridges, in which, when the snow melts, vegetation becomes vigorous. The coasts abound with seals and sea-fowl, but are almost inaccessible from ice during great part of the year, and during the remainder are rendered dangerous by icebergs.

GEORGIUM SIDUS, the name given by Herschel to the planet which he discovered, and which is now known as Uranus.

GEORGSWALDE, a town of Bohemia, on the borders of Saxony, 40 miles east by south of Dresden, connected by rail with Prague, Görlitz, and Dresden. It has iron-foundries, cotton-factories, brick-works, &c., and is, with the neighbouring town of Rumburg, the chief seat of the linen industry of Bohemia. Pop. (1890), 5808; (1900), 8131.

GEPHYREA, a class of cylindrical, unsegmented, marine worms, with a horny skin, and sometimes possessing a circle of tentacles. The chief genera are *Sipunculus*, *Bonellia*, *Phascolosoma*, &c.

GERA, a town of Germany, in the principality of Reuss-Schleiz, on the right bank of the White Elster, 35 miles S.S.W. of Leipzig. Among the chief buildings are the castle, the old Trinity Church, the town-hall, gymnasia, theatres, library, museum, town-hospital, &c. There are municipal water-works, electric tramways, scientific and artistic societies, &c., and manufactures of woollen, linen, cotton, mixed silk, camlet, and other goods; various mills, foundries, brick-works, breweries, carpet-works, &c., and a large trade in oil, spirits, &c. Pop. in 1900, 45,640.

GERACE, a town of Italy, in the province of Reggio di Calabria, on a hill, 36 miles E.N.E. of Reggio. With some good houses, it presents on the whole a mean appearance. Its principal edifice is the cathedral, laid in ruins by the earthquake of 1783, but since rebuilt. Pop. 9000.

GERANIACEÆ, a natural order of thalamifloral, dicotyledonous plants, the type of which is the genus *Geranium*. They are characterized by five sepals, often unequal, with imbricated æstivation, one of them being sometimes prolonged by a spur at the base; petals usually five, unguiculated, and equal or unequal; stamens twice or three times as numerous as the petals, filaments sometimes united; ovary with five unilocular carpels united round a

central axis, which is considered by some as a prolongation of the receptacle. On coming to maturity the carpels become detached at the base, and are thus raised by the style, which remains adherent; the seeds are pendulous, and without endosperm. The members of this order are herbaceous or suffrutescent. They are found principally in the temperate regions of Europe, in North America, at the Cape, and in Australia: chief genera *Geranium*, *Erodium*, *Pelargonium*, *Oxalis*, *Tropœolum*, and *Impatiens*.

GERANIUM, a genus of plants belonging to the natural order Geraniaceæ, having stamens generally monadelphous, and the five-lobed ovary terminated by a long thick beak and five stigmas. The genus contains numerous species, those growing wild in Britain being commonly known as crane's-bills (see in SUPP.). The so-called geraniums of gardens are mostly species of *Pelargonium*, and are natives of Southern Africa, where they are exceedingly numerous, and form a striking feature in the peculiar vegetation of that region. They are of easy cultivation, and may be raised from seed sown in the spring; but in the winter they require protection.

GÉRARD, FRANÇOIS PASCAL, BARON, one of the most eminent historical and portrait painters of the modern French school, born at Rome in 1770; died at Paris in 1837. He went to Paris when very young, and was apprenticed to a statuary. He afterwards spent some time with the painter Brenet, and in his eighteenth year become a scholar of David, but for years was driven out of his artistic course in consequence of the revolution. In 1793 he was included in the conscription, and appointed adjutant in an engineer corps; but David, without his knowledge, placed him on the jury of the revolutionary tribunal, which freed him from warlike service. But as he had the greatest aversion to the tribunal he feigned sickness, and walked almost always on crutches, so that he obtained his discharge before the time of Robespierre. In 1795 he exhibited his first painting, Belisarius, which was engraved by Desnoyers. Some time after he painted Cupid and Psyche, engraved by Godefroy. Encouraged by success, he after this turned his attention more to portraits. Having obtained the favour of Napoleon, he was loaded with honours, and selected to paint the battle of Austerlitz. This picture, though he engaged on it with reluctance, is the largest of all his paintings, and perhaps also the most successful. It has been engraved by Godefroy. Under Louis XVIII., after he had exhibited his large painting, the Entrance of Henri IV. into Paris, engraved by Toschi, he was appointed first court painter and baron. After the July revolution he struck his name off the list of court officers, in order to free the state from the obligation of paying him a large sum as court painter. Among his portraits, which exceed 250, of which at least 100 are full size, the most famous are those of Napoleon's family, of Murat's queen and her children, of Talleyrand, Talma, Mademoiselle Mars, Louis Philippe, and Madame Récamier. Of his historical pieces the best known are Ossian's Dream, Homer, Daphnis and Chloe, Corinne on the Promontory of Misenum (Madame de Staël's Corinne), St. Theresa Kneeling at the Altar, Thetis with the weapons of Achilles, and the Coronation of Charles X. Gérard was, not only in colouring but in conception, richer and less cold than David, and in consequence excelled so much in portraits.

GÉRARD, JEAN IGNACE ISIDORE, an eminent French caricaturist and book illustrator, was born at Nancy in 1803; died at Paris in 1847. Having gone, when a young man, to push his fortune in Paris, he succeeded in gaining admission to the studio of Lecomte. He commenced his artistic career by executing a collection of costumes for a speculator, and then published a series of lithographic drawings entitled Le Dimanche d'un Bon Bourgeois; followed by a set of sketches, illustrative of the various periods of life from childhood to old age. None of these achieved any great success; but his Métamorphoses du Jour, a representation, under the guise of animal heads, of the foibles and vices of humanity, became at once immensely popular, and established the author's reputation. Another path of distinction was opened up to Gérard by the revolution of 1830, which furnished him with a prolific storehouse of satirical subjects in the court and government of Louis Philippe. The institution of a censorship of designs put an end to this species of caricature, and he then turned his attention to the illustration of books, and produced pictorial editions of Béranger, La Fontaine, Gulliver's Travels, and Robinson Crusoe. In 1840–42 were published his Scènes de la Vie privée et publique des Animaux. Gérard is generally known by his pseudonym of Grandville, a name which his grandfather, a comedian, had assumed while on the stage.

GÉRARD, ÉTIENNE MAURICE, Count, Marshal, and Peer of France, born in 1773 at Damvilliers, in the department of Meuse; died at Paris in 1852. He entered the army of the north as a volunteer in 1791, and first fought at Fleurus under Jourdan. He next became adjutant to Bernadotte, whom he followed in the campaigns on the Rhine and in Italy. After the Peace of Campoformio he accompanied Bernadotte on his mission to Vienna, and by his courage saved his life during a popular commotion. At the battle of Austerlitz he was severely wounded, and appointed on the spot a commander of the Legion of Honour. In 1806 he made the Prussian campaign as brigadier-general, and was head of the general staff of the ninth army corps in 1809 under Bernadotte, who in the battle of Wagram intrusted him with the command of the Saxon cavalry. In 1810–11 he fought in Spain. In the Russian campaign he contributed to the taking of Smolensk, in the battle of the Moskwa he commanded the division of Gudin after that general had fallen, and at the Beresina, by his exertions to cover the passage with a portion of Ney's corps, saved the lives of thousands. When, after the departure of Murat, the viceroy Eugène took the command of the remains of the army on the Vistula, Gérard commanded the rear-guard, consisting of 12,000 Neapolitans. With this feeble force he kept the enemy at bay on the Oder, drove him back beyond the Elbe, and then took the command of the advanced posts. In the campaign of 1813 he commanded a division of the eleventh army corps under Macdonald. By boldly pressing forward, expressly against the orders of Macdonald, he wrested from the allies, at the battle of Bautzen, a victory already gained. Some days after, having been severely wounded in an affair of outposts, he was obliged to quit the army for some time. After he had again obtained the command of his division he drove the Prussians, under the Prince of Mecklenburg, near Goldberg, into Silesia. He now obtained the command of the eleventh army corps; but having been severely wounded, both in the battle of the Katzbach and on the second day of that of Leipzig, he was again obliged to leave the army. By the end of the year, however, he had so far recovered as to take the command of the reserve corps of Paris, formed of recruits, and to lead them against the allies. There was no limit to the self-devotedness and valour which he displayed to the last moment in the campaign of 1814. After Napoleon's abdication he had the difficult task of bringing back the garrison of Hamburg, and was intrusted with the general superintendence of the fifth military division. On Na-

poleon's return he immediately joined him, obtained the command of the army of the Moselle, and distinguished himself at the battle of Ligny. On the day of Waterloo he was under Grouchy's command. After the second restoration he left France for a time, but returned in 1817 and lived on his estate. In 1822 and 1827 he was a member of the Chamber of Deputies, and defended the charter against the Ultras. Though almost blind by the loss of one eye and the weakness of the other, he took an active part in the July revolution, was appointed minister of war, and shortly after marshal and peer of France. In 1832 he commanded the troops sent to procure the evacuation of the citadel of Antwerp. In 1835 he became grand chancellor of the Legion of Honour, and in 1838 commander of the national guards for department Seine, but resigned in 1842.

GERASA, GERASH, or JERASH, a ruined town of Palestine, about 20 miles east of the Jordan and 43 north-east of the Dead Sea, on the Jerash or Kerwan, a tributary of the Zerka, or ancient Jabbok, in an elevated region, where are some of the finest woods in Palestine. The ruins are very extensive, chiefly on the right bank, and so magnificent that they have been compared to those of Baalbec and Palmyra. They include a great colonnade or street of columns, a larger and a smaller temple, two theatres, a triple gateway resembling a triumphal arch, &c. Gerasa appears to be first mentioned in the first century B.C., when it was captured by Alexander Jannæus, king of the Jews; it was adorned by the Antonines in the second century; and in 1122 its castle was destroyed by Baldwin II. of Jerusalem. Early in the thirteenth century it was deserted. Its ruins were discovered by Seetzen about the beginning of the nineteenth century, and tourists now frequently visit them. A number of Circassians are now settled here, and have a small village adjoining the ruins.

GERBA or JERBA, an island off the coast of Tunis, in the Gulf of Cabes, considered by some to be the land of the Homeric 'lotus-eaters.' It is about 20 miles long by nearly as many broad, has a low surface covered with olives and date-trees, and is occupied by an industrious population. There are several villages. Pop. 35,000.

GERÊZ, SERRA DE, a mountain chain in Portugal, which ramifies from the mountains of Asturias and stretches between the basins of the Douro and Minho, from north to south, for about 18 miles. It consists generally of a succession of granite peaks, the loftiest of which, Murro de Burageiro, has a height of 4296 feet. Soult, when retreating in 1809, passed through a terrific gorge in this chain.

GERHARD, EDUARD, a distinguished German archæologist, born at Posen on the 29th of November, 1795; died at Berlin on the 12th of May, 1867. He first made himself favourably known by his learned and acute Lectiones Apollonianæ (Leipzig, 1816), which secured him a professorship in the gymnasium of his native town. This, however, he was soon after compelled to resign on account of a disease in the eyes. In 1819, and again in 1822, he travelled to Italy for scientific purposes, and it was during these journeys he was drawn to archæological studies. He was director of the Instituto di Correspondenza archeologico at Rome—a society formed for the promotion of archæological study—from its foundation in 1828, and in this capacity he succeeded in obtaining for it the patronage of the Crown-prince of Prussia, afterwards Frederick William IV. The services rendered by this institute under Gerhard's direction have obtained recognition throughout the civilized world. Gerhard remained at Rome till 1837, when he returned to Germany and was appointed archæologist at the Royal Museum of Berlin, and afterwards elected a member of the Academy and professor at the University. In 1860 he was elected a foreign associate of the French Institute. Among his numerous works (several of which are in Italian) are the following:—Antike Bildwerke (Stuttgart, 1827–44); Rapporto intorno ai vasi Volcenti (Rome, 1831); Auserlesene griechische Vasenbilder (Berlin, 1839–58); Etruskische Spiegel (Berlin, 1839–65); Etruskische und campanische Vasenbilder (Berlin, 1843); Trinkschalen und Gefässe (Berlin, 1848–50); Griechische Mythologie (Berlin, 1854–55). He also prepared the following descriptions of archæological collections:—1, In conjunction with Panofka, Neapels antike Bildwerke for the museum at Naples; 2, in conjunction with Platner a descriptive catalogue of the museum of the Vatican for the Beschreibung der Stadt Rom; 3, Berlins antike Bildwerke for the Berlin Museum (Berlin, 1834), to which must be added Neuerworbene antike Denkmäler, with two supplements (Berlin, 1836–55).

GERHARDT, CHARLES FREDERICK, the son of a manufacturer, was born at Strasburg, August 21, 1816, was educated at the Protestant school there, at the polytechnic school in Carlsruhe, and at Leipzig. His taste for chemistry was first awakened at Carlsruhe, and was afterwards established so firmly by Erdmann of Leipzig, that, in opposition to his father, who wished him to become a manufacturer, he resolved to devote himself entirely to the science. He left his father's house, enlisted in a Lancer regiment, was discharged after a few months, and then entered Liebig's laboratory at Giessen, where he was soon the most distinguished of his students. In October, 1838, he went to Paris, where he lived some years by teaching, and it was at this period that he translated Liebig's works into French. In 1844 he was appointed by Thenard professor of chemistry at Montpellier, but after four years he came back to Paris, and there, along with his friend Laurent, privately pursued the researches which have made their names so distinguished. He founded an institution for chemistry, which he directed for six years, but it does not seem to have been commercially successful. In 1855 he went back to Strasburg as professor of chemistry in the faculty of sciences and in the École de Pharmacie, but these posts he held for only a short time, as he died at Strasburg, August 19, 1856, having almost completed his fiftieth year. Shortly before his death he had been elected both by the Royal Society and the French Academy as a foreign member. Gerhardt is the author of several separate works in addition to the translations of Liebig already mentioned, namely, A Treatise on Qualitative and Quantitative Chemical Analysis, along with Chancel; Reports on the Progress of Chemistry with Laurent, and especially his two famous works, Précis de Chimie organique (Paris, 1844–45, in two volumes), and Traité de Chimie organique (Paris, 1853–56, in four volumes). His researches appeared in the Annales de Chimie et de Physique and other journals. Gerhardt was particularly distinguished by his power of methodizing and reasoning upon the facts of the science, and by basing his arguments not upon facts as these are commonly understood, but upon the general conception of system. Hence he attacked views held without question up to his time, because not in accordance with the opinions to which a strict logic had conducted him. He was in this way the first to reject the dualistic theory of salts, to introduce the new combining weights, or rather to subject more completely combination by weight to combination by volume; to originate the theory of types, and to furnish new ideas on classification, homology, and similar subjects. Few writers have

had so great an influence on the theory of the science as Gerhardt, for modern chemistry is little more than a development of his arguments and methods.

GERIZIM, MOUNT. See EBAL.

GERMAIN, ST., the name of a number of places in France, among which is St. Germain-en-Laye, a town in the department of Seine-et-Oise, about 6 miles north from Versailles and 11 miles W.N.W. from Paris, on the left bank of the Seine. The chief building is the château, dating from the thirteenth century, and reconstructed or improved by several subsequent monarchs, especially Charles V., Francis I., and Louis XIV. It was used as a prison during the revolution, and from 1830 to 1853 as a penitentiary for soldiers. In 1862 it was restored by Napoleon III., who established in it a museum of national antiquities. Under Louis XIV. the palace was the asylum of James II. and his family. James II. died here in 1701, and his wife in 1718. On the brow of a hill in the neighbourhood Henry IV. erected a fine modern château, called the Château Neuf, with gardens descending in magnificent terraces to the Seine. In this château was born Louis XIV. It was almost entirely demolished during the revolution. Only one pavilion, called the Pavilion of Henry IV., is still standing. St. Germain is also the birthplace of Charles IX. and Henry II. The forest of St. Germain, covering more than 10,000 acres, is one of the finest in France. It is inclosed by walls, and is bordered on the side of the Seine by a magnificent terrace nearly 2 miles in length, begun by Henry IV. and finished by Louis XIV. In the forest is the hamlet of the Loges, in which there is a school belonging to the Legion of Honour. Other buildings are the town-hall, the church containing the mausoleum of James II., the communal college (1898), &c. Pop. (1896), 13,760.

GERMAN CATHOLICS, a religious sect which sprung up in Germany about the close of the year 1844, which rapidly increased during the four or five following years, and then as rapidly declined. The immediate cause of the formation of this sect was the exhibition by Arnoldi, bishop of Trèves, of the holy coat preserved in the cathedral of that city, and said to be the coat of Christ. The bishop accompanied the exhibition of the holy coat by a promise of plenary indulgence to whoever should make a pilgrimage to Trèves to worship it. The announcement of this proceeding on the part of the Bishop of Trèves produced a feeling of general astonishment in Germany, and drew from a Silesian priest called J. Ronge, who had already been suspended from his charge on account of his independent views, a letter protesting against the exhibition of the holy coat and denouncing the projected pilgrimage as idolatry. This letter was published in the Sächsische Vaterlandsblätter on the 16th of October, 1844, and produced an amount of excitement that was quite unanticipated by the writer. Ronge was excommunicated, but this only increased the general enthusiasm in his favour, and when he entered into relations with Czerski, another independent priest who had seceded from the church, and made along with him an appeal to the lower grades of the clergy to unite in founding a national German church independent of the pope and governed by councils and synods, the appeal received a ready answer from a considerable number of those to whom it was addressed. A number of congregations belonging to the new body were formed in the more important towns, especially in Leipzig, under the celebrated Robert Blum, and in Magdeburg under the teacher Kote. In the spring of 1845 there were already about 100. At this time (March, 1845) a council was summoned to meet at Leipzig to deliberate on the affairs of the body. Only twenty congregations were represented there, but these nevertheless at once proceeded, under the presidency of Professor Wigard, to arrange a system of doctrine and practice which was to form the basis of union for the whole church. The Bible was recognized as the sole standard of faith, and its interpretation was left to reason, 'penetrated and animated' by the Christian idea. Only two sacraments were admitted, baptism and the Lord's supper. In matters of ritual each congregation was left free to carry into practice its own views. The organization of the new church was almost the same as that of the Presbyterian Dissenting churches of Scotland. Each congregation was to choose its own pastor and elders. Affairs of a general interest were intrusted to the management of a general council to meet every five years, but the decisions of this council were to be ratified by a majority of the congregations before they became valid. The confession of sins, the hierarchy of the clergy, and the celibacy of the priests were abolished, and the authority of the pope was not recognized. On the subject of purgatory nothing was declared either for or against it. The constitution of the new church was thus a Protestant one, but in some respects the German Catholics went even further than the majority of Protestants in a liberal direction, inasmuch as they claimed for all complete religious liberty, and declared their religion to be capable of development and modification with the progress of the human mind.

The church established on this basis had at first, as has already been stated, great success. The most eminent men of the liberal party, and the deepest thinkers of the time, regarded the movement with sympathy, or at least with interest. Gervinus expressed his belief that great benefits might result from it. Many Protestants, dissatisfied with the subjection of their religion to state supervision, joined the body, which at the end of 1845 counted 298 congregations. But it was not long before the spirit of opposition began to show itself. The majority of the governments in Germany, at the instigation both of the Protestant and the Roman Catholic clergy, began to use repressive measures against the new body. Prussia contented itself with regulating the exercise of their worship; but some of the other states went further. At Baden the adherents of the sect were deprived of their political rights. Austria took the course of banishing them from her dominions. But persecution from without did less hurt than the divisions within the body. Almost immediately after the meeting of the council at Leipzig a congregation had been formed at Berlin which refused to abide by its decisions. Czerski and Ronge, the two originators of the sect, became the leaders of two opposing parties within it, one of which, that headed by Czerski, clung to the traditions and doctrines of the Roman Catholic Church, rejecting only the supremacy of the pope and the union between church and state; while the other sought for more freedom, converted religion into a sort of popular philosophy, and began to mix up with it questions of politics, exhibiting strong democratic tendencies. These were most plainly manifested during the revolutionary epoch of 1848. The schism between the two parties was then complete. One section of the congregations of German Catholics professed to have only religious ends in view, while another section openly pronounced itself in favour of socialistic principles.

From the year 1850, however, there were several attempts to re-establish the unity of the body. An effort was made to reintroduce harmony by widening the basis of union. Instead of founding a religion, a council held at Gotha in June, 1859, proposed the

formation of a religious association or confederation into which all free Protestant and even Jewish congregations were to be admitted. Legislation in the different states had become more tolerant, and the carrying out of the scheme of the council of Gotha seemed to be at least practicable. But the result proved otherwise. The association consisted of too heterogeneous elements. While some of the members, receding further and further from orthodoxy, proclaimed simple deism as their religion and abolished baptism and the Lord's supper, others, on the contrary, lost themselves in an exaggerated mysticism. According to the most recent statistics there are still about 100 congregations of German Catholics in Germany; but their numbers only amounted to about 6200 in 1895. Complete information with regard to this sect will be found in Kampe's Das Wesen des Deutschkatholicismus mit besonderer Rücksicht auf sein Verhältniss zur Politik (Tübingen, 1850), and his Geschichte der religiösen Bewegungen der neuern Zeit (Leipzig, 1852–60).

GERMAN CONFEDERATION. See GERMANY.

GERMANICUS, CÆSAR, a Roman general, celebrated for his victories over the Germans, son of Claudius Drusus Nero and the younger Antonia, a niece of Augustus, justly esteemed for her virtues, which her son inherited. He was born B.C. 15. Tiberius, his paternal uncle, adopted him. He was married to Agrippina, the youngest daughter of M. Vipsanius Agrippa and Julia, the daughter of Augustus. When Augustus died in A.D. 14 Germanicus was at the head of the armies in Germany. Tiberius succeeded to the government. Germanicus was invited by several rebellious legions to assume the sovereign authority, but he refused. He then crossed the Rhine, and, surprising the Marsi in a drunken riot, made a horrible slaughter among them, and destroyed the Temple of Tanfana. Next year (A.D. 15) he defeated the Catti in a like manner, and after returning from this expedition proceeded to the relief of Segestes, who had sent to implore his assistance against his son-in-law Arminius (Hermann), by whom he was besieged. Germanicus delivered him, and took prisoner Thusnelda, wife of Arminius. Arminius then prepared for war, and Germanicus collected his forces on the Ems (Amisia). Marching into the heart of the country, he reached the Teutoburger Wald (Saltus Teutobergiensis), where Varus had been defeated in the time of Augustus, and where the bones of his legions still lay bleaching in the air. These were now buried by Germanicus, and a funeral mound raised over them. Meanwhile Arminius had collected his forces. A battle ensued, in which the defeat of the Roman legions was averted by Germanicus renewing the attack with fresh troops. Arminius retreated, and Germanicus was content to regain the banks of the Ems, and retired with honour from the contest which his army could no longer sustain. After having lost another part of his troops during his retreat by a violent storm, which wrecked the vessels in which they were embarked, he reached the mouths of the Rhine, and employed the winter in making new preparations for war against the Germans. He built a fleet of 1000 vessels, in order to avoid the difficult route by land through forests and morasses, and again landed at the mouth of the Ems, A.D. 16. Proceeding thence towards the Weser (Visurgis) he found the Cherusci assembled on the opposite bank with the intention of contesting the passage. Nevertheless he effected it, and fought a battle, which began at daybreak, and terminated to the advantage of the Romans, who suffered little loss. In a second engagement, which took place soon after, the Romans were again victorious. The Germans then returned into their forests. Germanicus re-embarked, and after having experienced a terrible storm, by which part of his fleet was dispersed, went into winter-quarters, but not until he had made another incursion into the country of the Marsi. This expedition was his last in Germany. Tiberius, jealous of the glory of the young hero, called him home under pretence of granting him a triumph. In order, however, to get rid of a man whose popularity appeared dangerous to him, he sent him, invested with almost absolute power, into the East, to compose the disturbances which had broken out there; at the same time he appointed Cn. Piso, whose proud, domineering, and inflexible character always thwarted the intentions of Germanicus, governor of Syria. Visiting Athens and Troy on his way, Germanicus hastened to Armenia to fulfil the mission on which he had been sent, by placing Zeno on the throne of Armenia, reducing Cappadocia to a province, and giving the command of Commagene to Q. Servæus (A.D. 18). In the following year he visited Egypt to gratify his taste for travel and antiquities, and on his return to Syria he was attacked by illness, and died at Epidaphne, near Antioch, on the 9th of October, A.D. 19. The terms on which he and Piso had lived together were such as to suggest the suspicion that the latter had poisoned him, but there is nothing to verify this surmise. At Rome unexampled honours were decreed to his memory.

GERMAN OCEAN. See NORTH SEA.

GERMAN SILVER, NICKEL SILVER, ARGENTAN, MAILLECHORT, PACKFONG, is an alloy of copper, nickel, and zinc in different proportions. There was obtained from the slags of the abandoned mines at Suhl, white metallic grains which were employed in the arts, and were shown to consist of copper and nickel, with traces of antimony, iron, sulphur, but no zinc. This differs, therefore, from argentan, which always contains zinc, though the amount varies. Among the varieties known, the following are mentioned:—Spoons and forks are made from 2 parts copper, 1 nickel, 1 zinc; knife and fork handles from 5 copper, 2 nickel, 2 zinc, a mixture closely resembling alloyed silver; addition of lead produces an alloy which appears well fitted for casts, and for making candlesticks, &c.; iron or steel, on the other hand, makes the alloy whiter, harder, and more brittle. Other mixtures are—8 copper, 3 nickel, 5 zinc; 8 copper, 3½ zinc, 2 nickel, having a yellow tint, or 3 nickel, a silver white, 4 nickel, a brilliant argentine appearance, or 6 nickel, the last capable of being worked when cold. The alloys are prepared in various ways; by melting the copper and nickel, and then adding the zinc; by alloying the copper and zinc, and copper and nickel, and then mixing the two alloys; or by fusing together all three properly disposed in a crucible, by the heat of a wind furnace. The properties of the alloy vary to some extent with the composition; the colour ranges from yellow to silver white; it has a crystalline texture, and requires care in hammering. It is harder than silver, and takes a good polish. Specific gravity, 7·2–8·9. It melts at a red heat, and if in contact with air the zinc burns off. It is attacked by the strong acids, but it is also affected by common organic acids, such as vinegar, and by some saline solutions. Large quantities of the nickel alloy are prepared at Sheffield to be made into cheap cutlery, spoons, forks, knives, &c. &c., which are sometimes afterwards silver-plated.

Chinese packfong or white metal was analyzed in 1776 by Engeström, who showed that it contained copper, zinc, and nickel.

GERMAN TINDER, or AMADOU, is prepared from *Boletus* (or *Polyporus*) *igniarius* and *fomentarius*, fungi which grow on willow cherry, birch,

GERMAN EMPIRE

BY J. BARTHOLOMEW, F.R.G.S.

British Miles 10 0 20 40 60 80 100

Kilometres 10 0 20 40 60 80 100

Railways

Longitude East 14 from Greenwich

oak, and other trees. They are sometimes so dry that they will continue to smoulder when ignited. But the tinder is usually prepared by boiling the fungus with water, beating in a mortar, and drying. Sometimes saltpetre, or even a little gunpowder, is added. Amadou has been used to stop bleeding, and also in surgery as a support, and for pressure and protection.

GERMANTOWN, formerly a post-town in Philadelphia county, Pennsylvania, 7 miles north of Philadelphia, but now included within the municipal limits of the city. A battle was fought here on the 4th of October, 1777, between the Americans under General Washington and the British under General Howe, in which the former were defeated.

GERMANY (Latin, *Germania*; German, *Deutschland*; French, *Allemagne*; Spanish, *Allemania*), the name given to a large part of Central Europe, and in one sense including all the countries in which the mass of the people are German in race and language. Parts of Switzerland, Austria, and Russia may thus be said to be German. The name, however, in its usual and more restricted application, is confined to those states which constitute the German Empire. Taken in this sense Germany is bounded on the north by the Baltic, Denmark, and the North Sea; west by Holland, Belgium, and France; south by Switzerland and Austria; east by Russia. The following table shows the elements of which the German Empire as now constituted is made up:—

	Area in sq. miles.	Population 1st Dec., 1900.	Pop. per sq. m.
KINGDOMS.			
1. Prussia	134,562	34,472,509	257
2. Saxony	5,787	4,199,758	726
3. Bavaria	29,286	6,175,153	210
4. Würtemberg	7,532	2,169,434	288
IMPERIAL TERRITORY.			
5. Alsace-Lorraine	5,602	1,717,451	306
GRAND-DUCHIES.			
6. Baden	5,821	1,866,584	322
7. Hesse	2,965	1,119,893	379
8. Mecklenburg-Schwerin	5,067	607,835	119
9. Mecklenburg-Strelitz	1,131	102,628	91
10. Oldenburg	2,481	399,183	161
11. Saxe-Weimar	1,396	362,873	259
DUCHIES.			
12. Brunswick	1,417	464,333	327
13. Saxe-Meiningen	953	250,683	264
14. Saxe-Coburg and Gotha	763	229,550	303
15. Saxe-Altenburg	511	194,914	379
16. Anhalt	885	316,027	358
PRINCIPALITIES.			
17. Waldeck	433	57,918	132
18. Lippe	469	139,238	296
19. Schaumburg-Lippe	131	43,132	329
20. Schwarzburg-Rudolstadt	363	93,059	257
21. Schwarzburg-Sondershausen	333	80,898	246
22. Reuss (elder line)	122	68,396	560
23. Reuss (younger line)	319	138,993	436
FREE TOWNS.			
24. Bremen	99	224,882	2,269
25. Hamburg	160	768,349	4,800
26. Lübeck	115	96,775	843
	208,703	56,360,448	270

The population in 1895 was 52,279,901, and in 1890, 49,428,470. The small island of Heligoland, now forming part of Prussia, was added to the empire in 1890. As each state is described under its own name, the description here is confined to leading features which belong to Germany as a whole.

Physical Features.—These are greatly diversified, and present such an irregular succession of mountains and valleys, table-lands and plains, as makes it extremely difficult to arrange them for the purpose of a distinct general description. The whole country may, however, be considered as consisting of a mountain region in the south, with a great northern plain between it and the sea. This mountain region does not in average height exceed 5000 feet, and is extremely complicated, consisting of a great number of separate ranges, which ramify in all directions, and become so interlaced with each other that the limits assigned to them are in many instances arbitrary. The only range which has any title to be considered as a common centre is the Fichtelgebirge, continued east by the Erzgebirge and the Riesengebirge, south-east by the Böhmerwald, west by the Thüringerwald, Rhöngebirge, and Spessart, and carried to its northern limit in the Harz. The western boundary of this region is formed chiefly by the Schwarzwald and Odenwald. Across the Rhine are the Vosges Mountains, on the French frontier. The great plain in the north extends without interruption to the German Ocean and the Baltic, and flattens down so much when it approaches them as in many places to require artificial protection from their waves. Its length west to east may be about 550 miles, and its average breadth 200 miles. To all appearance it has once been covered by the sea, alluvial deposits of great depth being spread over almost every part of its surface, and generally with so large a proportion of sand as to make it for the most part naturally unfertile.

Rivers.—Germany is remarkably well watered. Its central mountain region and plateau forms part of the great water-shed of Europe, and either gives rise to more than one of its most important rivers or sends them their principal affluents. Thus the Danube, rising near its western extremity, proceeds across it in an eastern direction, and does not quit it till it about reaches the extreme east of Bavaria. The Rhine, in like manner, though it neither rises nor terminates within Germany, flows within it for the greater part of its course, and is considered by the Germans as their national river *par excellence*. After these come the Elbe, strictly speaking the greatest river of Germany, inasmuch as almost its whole basin lies within it; the Oder, Weser, Main, Neckar, Mosel, Ems, and Eider—all of which are navigable.

Minerals.—Germany possesses numerous and varied mineral riches, the most important of which are common coal and brown coal, iron, zinc, lead, and salt. In respect of its mineral wealth the Prussian monarchy especially takes a prominent place among the states of Europe, and in the production of zinc surpasses all other countries in the world. After Prussia the Kingdom of Saxony is the most important mining country in Germany. Gold and silver are obtained in the Harz Mountains and in the Kingdom of Saxony; gold to a limited extent also in Bavaria. Iron is chiefly obtained in Prussia, Alsace-Lorraine, Bavaria, Brunswick, and Saxony. Copper, lead, and zinc are found chiefly in Prussia. Tin is found only in the Kingdom of Saxony; quicksilver, antimony, and sulphur are mainly confined to Prussia; nickel and alum are obtained chiefly in the same state; arsenic chiefly in Saxony, graphite in Bavaria, and blue and green vitriol in Prussia and Saxony. The most extensive coal-beds lie in the kingdoms of Prussia and Saxony. Brown coal is obtained also in the Duchy of Anhalt. Rock-salt is obtained in considerable quantities in Prussia, Anhalt, and Würtemberg. Marble, alabaster, kaolin, calamine, molybdenum, cinnabar, lime, asbestos, slates, millstones, freestone, trass and sundry precious stones—as amethysts, garnets, &c.—are also found in various localities. Germany is likewise extremely

rich in mineral waters, including chalybeate, sulphureous, alkaline, saline, and warm, of all kinds; but most in the southern portion of the country.

Climate, Flora and Fauna.—The climate of Germany is fairly uniform throughout, the lower latitude of the southern portions being compensated by greater elevation above the level of the sea. January is always the coldest month, its mean temperature being generally below freezing-point, except on the North Sea coast, the north-western plain, and the Upper Rhine valley. The mean temperature of the warmest month (usually June) generally ranges from 60° to 66° F. The range of mean annual temperature is from 36·3° on the Brocken to over 50° in the Upper Rhine valley and parts of Bavaria. The greatest annual rainfall is that of the Upper Harz region (67 inches); for Rhenish Prussia and Westphalia it is 41 inches, for the Upper Rhine valley from 23 to 27, and rather less for the Berlin region. The best climates are those of the Upper Rhine valley, and the valleys of the Moselle, Main, and Neckar. Germany belongs entirely to the region of the Middle European flora, and is crossed by the northern limit of vine cultivation (about 51°–52° N. lat.). The total number of flowering plants in its flora is about 2500. About a quarter of the surface is under forest, the largest proportional amount being in Hesse-Nassau. The chief trees are the beech and oak, mainly in the west; pines, chiefly on the northern plain; firs, in the mountainous districts; birch and alder, chiefly in the north; larch, on the southern mountains; and chestnut, in the Upper Rhine valley. There are three faunal zones—Alpine, Upper German, and Lower German—the first being the richest. The fauna is mainly a forest one, and includes 65 mammals and 225 birds. Notable species are the wolf, badger, mink, beaver, wild cat, wild boar, elk, marten, bear, and one kind of tortoise.

Agriculture, &c.—Germany is becoming less and less an agricultural and more and more a manufacturing nation, but in many parts agriculture is still the main business of the population. About 65 per cent of the total area is under cultivation, and of this more than half is under the chief cereals, fully a sixteenth under other corn crops and leguminous plants, nearly a sixth under potatoes, turnips, sugar-beet, cabbages, &c., whilst rather less than a fiftieth represents orchards and gardens. The empire does not now grow the cereals in sufficient quantity to meet its own requirements, but is becoming increasingly dependent upon imports, especially of wheat and barley, from Russia, Hungary, Roumania, and North America. Of the chief cereals, rye occupies the largest area, and next in order come oats, wheat, barley. Spelt is grown in the south, and maize also to a small extent. Buckwheat is a northern crop, and potatoes, though grown all over the empire, are most widely cultivated in the north. Flax and hemp thrive best in the central mountainous districts. Hops are raised chiefly in Bavaria (Main valley below Nürnberg), Baden (Carlsruhe district), Hagenau district west of Rhine, Würtemberg, and Posen; sugar-beet in an extensive region from Leipzig to Brunswick, including Magdeburg and Halle, around Bautzen, in the Breslau-Liegnitz district, near Danzig, Neu-Strelitz, Bromberg, Frankfurt-on-the Oder, &c.; tobacco chiefly in Baden, the Bavarian Palatinate, and Brandenburg. The chief wine-growing region is the Rhine valley from Baden to Cologne, with the valleys of the Moselle and the Neckar; but other important districts are the Main valley about Würzburg, the valley of the Saale in the Naumburg-Weissenfels district, the Elbe valley at Dresden, parts of the Rhine valley above Strassburg, and a small district north of Görlitz. The growing of vegetables and market-gardening generally is most extensively carried on around Berlin, Dresden, Leipzig, Erfurt, Hamburg, Brunswick, and Düsseldorf. Fruit-growing is most successful in the middle and south of the empire, especially in Saxony, Franconia, and the Middle Rhine valley. Good horses are reared in the provinces of East and West Prussia, Mecklenburg, Holstein, and Hanover; cattle thrive best on the North Sea coast, in Franconia, the Vogtland, and the Alpine districts; sheep-breeding is declining, but good wool is still obtained from Saxony, Silesia, and Brandenburg. Swine are bred chiefly in Westphalia, Mecklenburg, Pomerania, Bavaria, and Prussian Saxony. The imports of sheep, pigs, butter, cheese, and eggs are increasing rapidly.

Manufactures.—The recent progress of German manufacturing industry is without parallel among European nations, and is due in large measure to the great advance in technical education. The textile industries give employment to about a million persons, the chief branches being as follows:—Cotton in Upper Elsass (Mülhausen), Saxony (Chemnitz), Rhenish Prussia (München-Gladbach, Elberfeld-Barmen), Würtemberg (Reutlingen), Bavaria (Bayreuth, Augsburg), Baden, and Silesia (government of Liegnitz); wool-spinning in Rhenish Prussia, Saxony, Würtemberg, and Elsass; woollen cloth in the above districts and also in Lower Lusatia and south-east Brandenburg (Cottbus-Serau district); hosiery in Chemnitz, Glauchau, Plauen, Thuringia, Würtemberg, and Elsass; carpets in Berlin, Barmen, &c.; linen-weaving on frontiers of Silesia and Bohemia, Saxony (Zittau), and the Bielefeld district; jute goods in Brunswick, Meissen, &c.; silk in Crefeld, Elberfeld-Barmen, Berlin, Aix-la-Chapelle, Baden, and Lorraine. Three or four hundred thousand persons are employed in the iron and steel manufacture. Its chief seats are: Rhenish Prussia and Westphalia from Düsseldorf to Dortmund, and the Aix-la-Chapelle district; Upper Silesia; and the southernmost part of the Rhine province between Luxemburg and the Palatinate; but the ironworks of Hanover, Saxony, Thuringia, Bavaria, and Würtemberg are also important. The smaller iron industries are chiefly carried on in Solingen, Hagen, Gevelsberg, Remscheid, Aix-la-Chapelle, Iserlohn, Lüdenscheid, Altena, &c. Over 200,000 men are employed in the machinery manufacture, mainly in Rhenish Prussia, Westphalia, Saxony (kingdom and province), Brandenburg (Cottbus to Serau), Silesia, Bavaria, Elsass, &c. Cassel is the chief place for locomotives, and Berlin, Chemnitz, Dortmund, and Düsseldorf are the chief centres for steam-engines and machine-tools. Shipbuilding is carried on in Bremen, Danzig, Elbing, Flensburg, Hamburg, Kiel, Lübeck, Rostock, Stettin, and Wilhelmshaven, and river steamers are built in Dresden, Mainz, Munich, and elsewhere. Other manufactures of importance are: Plate-glass (Rhenish Prussia, Westphalia, Silesia); bottle-glass (Saxony, Rhenish Prussia, Bavaria, Hanover, Lusatia, &c.); earthenware (Silesia, Hesse-Nassau); porcelain (Meissen, Berlin, Dresden, Silesia, Rhenish Prussia, Thuringia, &c.); bricks, chiefly in north; tanning (especially Mainz, Worms, Kirn, Malmedy, Saxony); boots and shoes (Pirmasens, Mainz, Balingen, Offenbach, Thuringia, Saxony, Silesia); gloves (Saxony, Würtemberg, Berlin); fur goods (Leipzig); gold, silver, brass, and bronze wares; toys (especially Nürnberg and

Thuringia); optical, medical, mathematical, musical, and other apparatus and instruments; telegraphic and electrical apparatus and machinery (Aix-la-Chapelle, Berlin, Breslau, Chemnitz, &c.); calcium carbide and acetylene; drugs; aniline and alizarine dyes; soap and candles; beet-sugar (Saxony, Silesia, Rhenish Prussia, Thuringia; trade centres are Magdeburg, Breslau, Berlin, Cologne); brewing (best in Bavaria, Berlin, Dresden); distilling; furniture; cigars (Saxony); lithographic stones (Solnhofen); &c. The cottage system of industry is gradually being displaced by the factories, but it is still common in some branches.

Internal Communication.—The excellent river-system has been supplemented, especially in recent times, by the construction of numerous canals. The total length of railway controlled by the Union of German Railways in 1900 was 55,963 miles, of which 30,242 were in the German empire, the rest being in Austria-Hungary, Netherlands, Luxemburg, Roumania, &c. The total railway mileage of Germany in 1900 was 31,647, of which Prussia had 20,672, Bavaria 4192, Saxony 1878, Baden 1210, Würtemberg 1163, and Elsass 1155. Of the total, 28,547 miles were state lines. Bavaria and Würtemberg have separate postal and telegraph administrations.

Commerce and Shipping.—The territory of the customs union known as the Zollverein now comprises the whole empire, with the addition of Luxemburg and the Austrian communes of Jungholz and Mittelberg, and, with the exception of the free port of Hamburg, part of Cuxhaven, the free ports of Bremerhaven and Geestemünde, Heligoland, and some southern frontier communes in Baden. The total imports in 1899 were valued at £289,181,400, and the exports at £218,420,450. The imports came mainly from the United States, Britain, Austria-Hungary, Russia, France, and Belgium, and the exports were sent chiefly to Britain, Austria-Hungary, Russia, United States, Netherlands, Switzerland, and France. The chief imports were cereals (£27,515,500), wool (£21,410,000), timber, cotton, hides, silk, coal, cattle; and the chief exports were iron goods (£14,045,000), drugs (£12,660,000), coal (£11,315,000), woollens (£10,860,000), cottons (£10,305,000), sugar (£10,205,000), machinery (£8,900,000), iron, silks, &c. The mercantile marine is steadily increasing in numbers, and now includes the fastest transatlantic steamers. On January 1, 1899, it comprised 3713 vessels (registered tonnage, 1,639,552), of which 1223 (registered tonnage, 1,038,391) were steamers. The principal seaports of Germany are Hamburg, Bremen, Lübeck, Stettin, Kiel, Danzig, and Königsberg.

Finance.—The total revenue and expenditure of the empire, which are made to balance, were each £103,332,200 in 1900–1. The chief sources of revenue are the customs, excise duties on tobacco, sugar, salt, and spirits in all the states, an excise duty on beer except in Bavaria, Würtemberg, Baden, and Elsass, stamps, posts, and telegraphs except in Bavaria and Würtemberg, railways, and the *Matricular-Beiträge* paid by the federated states to the imperial treasury in proportion to population, but with additions in the case of those states which administer their own posts, telegraphs, and beer duties. The chief heads of the expenditure were the army, navy, civil administration, &c. The debt of the empire in 1899 was £123,398,420, against which are to be set the invalid fund of £19,548,380, and the war treasure fund of £6,000,000.

Constitution.—The constitution of the German Empire is based upon the decree of the 16th of April, 1871. The presidency of the empire is the privilege of the King of Prussia, to whom belongs the hereditary title of *German Emperor*. The legislative authority is vested in the *Bundesrath*, or Federal Council, and the *Reichstag*, or Imperial Diet. The prerogatives of the emperor are to represent the empire in its relation to other states, to declare war and conclude peace in name of the empire, to contract alliances and conclude treaties with foreign states, to accredit and receive ambassadors. The assent of the Bundesrath is, however, necessary to a declaration of war, unless the imperial territory be invaded, or its coasts attacked. The emperor has also the supreme command of the army and the navy, summons, opens, prorogues, and concludes the Bundesrath and Reichstag, appoints and dismisses officials of the empire, and superintends the consulate.

The Bundesrath consists of 58 representatives of the members of the empire. Of these 17 are returned by Prussia, 6 by Bavaria, 4 each by Saxony and Würtemberg, 3 each by Baden and Hesse, 2 each by Mecklenburg-Schwerin and Brunswick, and one each by Saxe-Weimar, Mecklenburg-Strelitz, Oldenburg, Saxe-Meiningen, Saxe-Altenburg, Saxe-Coburg-Gotha, Anhalt, Schwarzburg-Rudolstadt, Schwarzburg-Sondershausen, Waldeck, Reuss-Greiz, Reuss-Schleiz, Schaumburg-Lippe, Lippe-Detmold, Lübeck, Bremen, and Hamburg. Alsace-Lorraine (Elsass-Lothringen) is represented in the Bundesrath by four commissioners without votes. Every year or every session standing committees of the Bundesrath are appointed by the members from their own number: 1, for the army and fortifications; 2, for the navy; 3, for the customs and other imposts; 4, for trade; 5, for railways, posts, and telegraphs; 6, for justice; 7, for finance; 8, for foreign affairs; and 9, for the affairs of Alsace-Lorraine.

The Reichstag is elected by secret voting in all the states, every German above twenty-five years of age having a right to vote in the state in which he resides. Members of the army and navy cannot exercise their right of voting while their period of service lasts. Anyone may be returned to the Reichstag who has the right of voting, and who has belonged for at least a year to one of the states. As a rule, one member is returned to the Reichstag for every 100,000 of the inhabitants of each state, but every member of the empire sends at least one deputy, even although its population is under that number. At present the Reichstag consists of 397 members, namely: 236 from Prussia and Lauenburg, 48 from Bavaria, 23 from Saxony, 17 from Würtemberg, 15 from Alsace-Lorraine, 14 from Baden, 9 from Hesse, 6 from Mecklenburg-Schwerin, 3 each from Saxe-Weimar, Oldenburg, Brunswick, and Hamburg, 2 each from Saxe-Meiningen, Saxe-Coburg-Gotha, and Anhalt, and 1 each from the other states. Proposals of laws are laid before the Reichstag by members of the Bundesrath, or by commissaries appointed by it. Every member of the Bundesrath has the right of appearing in the Reichstag, and has a right to be heard there at any time to represent the view of the government. No one can at the same time be a member of the Bundesrath and the Reichstag. The Reichstag lasts for five years. To dissolve it within that period a decree of the Bundesrath and the assent of the emperor are necessary. In case of a dissolution new elections must take place within sixty days, and the new Reichstag must meet within ninety days. To render an imperial law (*Reichsgesetz*) valid there must be a majority of votes in its

favour both in the Bundesrath and in the Reichstag, and nothing else is required. Changes in the constitution may be effected in the same way. Disputes between two or more states of the empire, in so far as the common law courts are incompetent to deal with them, may be settled by the Bundesrath on an appeal being made to that body by either of the parties to the dispute.

The empire has the sole right of legislating on all matters connected with the army and navy, the finances of the empire, commerce, posts and telegraphs (except in Bavaria and Würtemberg), railways, in so far as they are deemed necessary for the defence of the country, and proposed modifications of the constitution of the empire. Certain other matters are left largely to the management of the individual states.

Army and Navy.—Service in the army or navy is obligatory on every German capable of bearing arms, from the age of seventeen to that of forty-five. Within this period seven years must be passed in the standing army or in the fleet (generally the years between twenty and twenty-eight), two of them in active service (three for cavalry and horse-artillery). The remainder of the seven years are passed in the reserve. The next five years are passed in the first class or 'ban' of the Landwehr or Seewehr (land or sea defensive forces); service continuing in the second class or ban up to the age of thirty-nine. Of young men becoming liable to service every year, only a certain number chosen by lot join the regular army; the remainder enter the Ersatztruppen or dépôt reserve, in which service lasts for twelve years. The Landsturm consists of all from seventeen to forty-five who are not otherwise in service; being divided into two bans or sections; the first comprising men from seventeen to thirty-nine, the second those from thirty-nine to forty-five. This force is only called upon for active service in case of an invasion of the country. Young men above seventeen years of age, who are able to pass an examination upon general subjects, and who volunteer for active service in the army, and agree to equip and maintain themselves during active service, are admitted into the reserve after one year's service. This privilege is also granted to teachers in primary schools, and Roman Catholic priests ordained before a certain age are exempt from active service and drill altogether.

Organization and Strength of the Army. — The German army consists of twenty-three army-corps, of which three are furnished by Bavaria, two by Saxony, one by Würtemberg, and the remaining seventeen by Prussia and the other states. The Bavarian corps are numbered separately, and in time of peace form a separate army under the King of Bavaria. The Prussian Guard Corps, with headquarters at Berlin, is recruited from all Prussia, but the others have districts allotted to them. The corps are grouped into five inspections, each comprising from three to five corps. The following is a list of the head-quarters of the various corps arranged in inspection groups, the first-mentioned town in each being the head-quarters of the inspection: Berlin—Königsberg, Stettin, Altona, Hanover, Danzig; Dresden—Posen, Breslau, Dresden, Leipzig; Hanover — Munster, Coblentz, Cassel, Stuttgart, Frankfort-on-the-Main; Munich—Berlin, Magdeburg, Munich, Würzburg, Nürnberg; Carlsruhe—Carlsruhe, Strassburg, Metz. Each corps has ordinarily two divisions, each comprising infantry, cavalry, and field artillery. Each army-corps district is divided into two divisional districts, and from four to six brigade districts. Each brigade district is subdivided into from one to six landwehr districts, and the total number of these district commands is 293. In case of war the army-corps are brought up to their full complement of men by drawing on the reserve and the landwehr. In such times the whole German army is divided into three parts—field troops, dépôt troops, and garrison troops.

The following table shows the total strength of the German army on the peace footing in 1900:—

	Officers.	Rank & File.
Infantry,	13,314	335,797
Cavalry,	2,406	56,819
Field Artillery,	2,980	52,622
Foot Artillery,	872	18,730
Pioneers,	571	12,504
Train,	322	6,213
Railway, Telegraph, and Balloon Services,	237	5,175
Others,	3,142	3,276
Total,	23,844	491,136

Under the Army Act of 1899 the peace effective is to be gradually increased so as to reach 495,500 in 1903, and that number is to be maintained till March 31, 1904. The war strength is now estimated at about 3,000,000 men.

Strength of the Navy.—The German war fleet has been greatly increased in recent years, and the rate of increase is likely to be maintained for some time. By the law of June 14, 1900, the effective strength (excluding torpedo-boats and some others) has been fixed as follows: A fighting fleet comprising two admiral's flag-ships and four squadrons, each of eight ships of the line, eight large and twenty-four small cruisers, a fleet, for service abroad, of three large and ten small cruisers; a reserve of four ships of the line, three large and four small cruisers. The present strength of the imperial navy is as follows: 14 battleships of the line, 8 armoured coast-defence ships, 13 armoured gun-boats, 11 large cruisers, 25 small cruisers. 5 gun-boats, 16 school ships, and thirteen others, besides torpedo-boats. The personnel of the navy is recruited from the maritime and semi-maritime population of the empire. The total is at present about 30,000 men.

Money, Weights, and Measures.—By the law of Dec. 4, 1871, a uniform gold standard was introduced for the whole German Empire, it being decreed that out of 1 lb. of fine gold 139½ pieces of an imperial gold coin should be struck, the tenth part of which should be called a mark, and divided into 100 pfennige; that an imperial gold coin of the value of twenty marks should also be struck at the rate of 69⅔ to 1 lb. of fine gold; and that these coins should be made of an alloy containing 900 parts of gold and 100 parts of copper. The same law ordered the adoption of the mark as the general unit of the German coinage, commencing from the 1st of January, 1875. By the supplementary law of May 6, 1873, it was enacted that two-mark and five-mark pieces should also be issued, the former in silver, and the latter partly in gold and partly in silver. The ten-mark piece (*krone*) and twenty-mark piece (*doppelkrone*) are nearly equal in value to the English half-sovereign and sovereign respectively. The old silver thaler (=3 marks) is still legal tender.

Since the 1st of Jan. 1872, the French metrical system of weights and measures has been in force throughout the German Empire. It had previously been adopted by a law of the diet of the North German Confederation, and under the constitution of the new German Empire it was arranged that the new system of weights and measures should be introduced into the South German states, according to the

terms of separate treaties previously concluded by them with the North German Confederation. As the values of the different units of the metric system are given in the article DECIMAL SYSTEM, it will be sufficient here to give the German names of the various denominations of that system:—

Measures of Length—

Das Millimeter or Der Strich,	= the French	Millimètre.
,, Centimeter or ,, Neuzoll,	= ,,	Centimètre.
,, Decimeter,	= ,,	Décimètre.
,, Meter or ,, Stab,	= ,,	Mètre.
,, Dekameter or Die Kette,	= ,,	Decamètre.
,, Kilometer,	= ,,	Kilomètre.

The new German mile is equal to 7500 meters.

Measures of Surface—

Das Quadratmeter or Der Quadratstab,	= the French sq.	Mètre.
,, Ar,	= ,,	Are.
,, Hektar,	= ,,	Hectare.

The unit of the measures of capacity is Das Kubikmeter or Der Kubikstab = the French Stère.

In liquid measure the following terms are used:—

Das Liter or Die Kanne,	= the French	Litre.
,, Hektoliter or Das Fass,	= ,,	Hectolitre.

A measure equal to half a liter is called a Schoppen, and one equal to fifty liters a Scheffel.

Measures of Weight—

Das Milligramm,	= the French	Milligramme.
,, Centigramm,	= ,,	Centigramme.
,, Decigramm,	= ,,	Décigramme.
,, Gramm,	= ,,	Gramme.
,, Dekagramm,	= ,,	Décagramme.
,, Kilogramm,	= ,,	Kilogramme.

Half a kilogramm is one pfund; fifty kilogramms, or 100 pfund, make one Centner; and 1000 kilogramms one Tonne.

HISTORY OF GERMANY.—The territory to which the ancients gave the name of Germany was much larger than the modern territory of the same name. It comprised to the north Denmark, Sweden, and Norway, and on the south Pliny makes it extend as far as the Alps, but up till the time of Cæsar the southern boundary was the Danube, beyond which the Celts inhabited. The boundaries generally given are, on the north, the North Sea (Mare Germanicum) and the Baltic (Mare Suevicum); on the south the Danube; on the west the Rhine; on the east the Vistula, Sarmatia, Dacia, and the Carpathian (Sarmatian) Mountains. The boundary on the east, with Sarmatia and Dacia, is not exactly defined, and on the west the Rhine was only a nominal or formal boundary. The Germans had extended beyond the Rhine in the time of Cæsar, who gives this boundary. The Belgæ and the Treviri, who occupied Alsace, were at least mixed races; and Ptolemy gives the names Germania Superior and Germania Inferior to two divisions of Belgica, extending along the west bank of the Rhine, from the sea to the Sequanian territory, near Basel. These divisions are also mentioned by Tacitus as forming two of the six divisions of Gaul. Germany east of the Rhine was called Germania Magna or Barbara. Pliny enumerates sixty-eight tribes and ninety-four towns in Germany.

Germany, especially the southern part, was covered in the time of the Romans by extensive marshes and forests, which were inhabited by the elk, the urus, the bear, the wolf, the boar, the wild cat, and the deer. The population was, however, large, particularly in the north and east, the chief indication of which is the number of the armies, or rather of the armed tribes, which these districts from time to time sent out, and by which at length the Roman Empire was overwhelmed.

From language and other indications the Germans are supposed to have migrated from Upper Asia, passing by the Caucasus and the north of the Caspian and Euxine Seas, to Europe. This immigration must have taken place in non-historical times. There is no mention of it in the national legends, and the people considered themselves autochthones, as they were also regarded by the Romans.

The ancient Germans bore the greatest resemblance to the Celts. They are described as tall, handsome, fair, with blue eyes, which are said to be fierce in expression, and light or red hair, which they rendered bright with a soap which they used as a dye. Both men and women, except slaves, whose hair was cut for distinction, wore the hair long, and red hair, which became fashionable among the Roman ladies, was made an article of export. The women are said to have been almost equal in size and strength to the men. The Germans cultivated the land, but some tribes were half nomad, and the chief occupations of all were war and the chase, together with the breeding of cattle. They had horses, dogs, oxen, pigs, sheep, and goats. The horses were small but strong; the dogs were suited for the chase. Pigs were numerous, and ham formed an article of export. The oxen were small, but the cows yielded a good supply of milk. The houses of the fixed tribes were commonly of clay, and showed no constructive art. They generally stood apart, and were rarely collected into villages. A cloak of wool or skin formed the principal article of male attire; the women wore close-fitting garments of their own construction, and at a later period men of superior rank also wore close-fitting garments. A shield of wood, covered with leather, was generally the only article of defensive armour; sometimes the skin of a horned animal's head, with the horns on, was used as a helmet. Axes, spears, clubs, swords, slings, bows and arrows, were among the offensive armour, the first being the most common. Weapons were made at first of stone, and afterwards of metal. Their food consisted of flesh roasted, or merely dried and smoked, milk, butter, eggs, fish, and especially oatmeal porridge. Their chief drink was beer, made from wheat or barley. At all their feasts they drank to excess, and as this induced fighting, the women generally left before the drinking began.

The most distinctive characteristic of the Germans was, of course, their warlike character. Even the women followed the armies, tended the wounded, and sometimes actively joined in the fight. The men were arranged in battle, as in their marches, by tribes; tactics were unknown, and although their attacks were furious, they were unable to bear the tedium of a campaign. Their love of liberty is represented as extreme; but it is also said to have been overcome by their passion for gambling. A loser would often pledge his personal liberty as his last stake, and suffer himself to be sold as a slave. This would at least have the good effect of curing him of gaming; as a German slave could have no property, he would have nothing left to play for. They were passionately fond of music, especially of singing. It is to these northern nations that we owe the first rude combinations which have since been fashioned into modern harmony. The music of the south was chiefly rhythmic and melodious, and classic ears could not have endured the shapeless masses of sound which preceded the development of the laws of harmony. They sang at weddings and funerals, and on going into battle, when they are said to have devoted their enemies with frightful imprecations to the gods of war and thunder. Marriage was generally contracted late, and required the general consent of kinsmen. The bride received the dowry from the husband. Women are said to have been more highly honoured among the Germans than amongst almost any other semi-barbarous race. This testimony comes from both ancient and modern

sources. The chivalry of mediæval Europe is generally attributed to the spread of German habits, together with the influence of Christianity. This concurrence of evidence cannot be without foundation, but there is probably a good deal of sentimental exaggeration in it. The warriors, at all events, are represented to have been lazy; and to have left the hard work of cultivating the fields a good deal to the women and old men. The Romans in this and other respects set up the Germans as models of virtues which were partly drawn from their own imagination. They represented them as faithful and trustworthy, but this description seems only to apply to their dealings with friends. With the narrow morality of an uncultivated people they seem to have considered fraud as well as force, lawful against an enemy. The young men received their armour in public assembly from their parents or kinsmen at the age of twenty, and afterwards enjoyed the rights of freemen.

About the tenure of land there appears to have been different customs. It seems in some cases to have been regarded as public property and under the control of the magistrates, in others to have been held by a hereditary title. Each tribe or nation was divided into four classes:—1. The nobles, from whom the king and chiefs of the districts, or pagi, were chosen. 2. The freemen, who, with the nobles, had the right to choose their residence and to hold heritable property. They were obliged to serve in the armies, of which they formed the chief strength, and to attend the popular assemblies. 3. The freed men, a middle class between freemen and slaves, had no landed property but farmed the land; they served in the armies, but were not admitted to the popular assemblies. 4. The slaves, who were entirely in the power of their masters, who could dispose of their lives, control their marriages, and rule over them with undisputed power. They were employed both in domestic service and in field labours. They are said to have been tolerably well used, and to have been better off than Roman slaves. At the head of each of the tribes, which lived independently in time of peace, there was in general a separate king or chief, elected by the nobles in a free assembly of the people. Each tribe was divided into military districts, and each district had its own magistrate, who was assisted in the administration of justice by a college of 100 men. The magistrates were elective, and some tribes were governed by them alone. In time of war the king of the tribe was frequently superseded by a leader chosen for one or more tribes, who held the civil as well as the military power. The popular assembly, attended by all the freemen, controlled the power of the king, and had also the power of trying capital offences. In earlier times the popular assembly could depose the king. It met regularly at new or full moon, and also on all emergencies requiring its intervention. The freemen appeared in these assemblies in full armour. The meetings generally ended in hard drinking. Justice was also administered in the open air by judges assisted by a jury. Trial by lot or judicial combat was sometimes permitted. Trials were also wound up with a drinking bout. In later times the customs of the Germans formed the basis of various written codes, as the Salic, Ripuarian, Burgundian, but in the earlier period there were no written laws. Punishment in general took the form either of vengeance or compensation. The former was the right of the injured, the latter the adjudication of the tribunals. A family one of whose members was slain could pursue the murderer to death, but this vengeance was generally commuted by the tribunal for a fine. In like manner other offences were dealt with by way of compensation. A freeman could only be beaten by order of a priest, and banishment or imprisonment was only inflicted for political offences. Fines were in money, horses, cattle, &c. The only non-political offence that was capital was insolvency. Cowards, traitors, and persons guilty of unnatural crimes were put to death. History, as well as law, was propagated by tradition, and by the songs of bards. These, when recording warlike deeds, were frequently sung before or during the battle.

The accounts of the religion of the Germans are considerably obscured by the Roman habit of giving their own names to foreign gods. They worshipped Woden or Odin; Thor, the god of Thunder; Freir, the wife of Woden; Tuisco, the ancestor of their race; Mannus, his son, and other deities, besides the sun, moon, and stars. Their worship was conducted to a great extent in the open air in mountains, forests, rocks, and caves. Their priesthood, although they had a distinct caste, seems to have possessed a patriarchal character. A father was the priest of his family. Each tribe had its peculiar secondary deities, both benevolent and malignant. The priests possessed considerable power. From their religious rites they told the will of the deity in regard to public undertakings, which means that they dictated their own will, or the orders of their chief, to the people. They presided in the popular assemblies. There were also priestesses, who possessed the gift of prophecy. Sometimes human sacrifices were offered. The booty taken in war, and sometimes prisoners, were sacrificed to the gods. There were a few simple trades among the Germans, such as carpenters, smiths, and masons, and the women span and weaved. On the coast and the larger rivers, particularly the Rhine and Danube, there was a rudimentary commerce. Furs, hides, ham, goose-quills, red hair, and soap for dying were exported, and wine, coins, trinkets, and other commodities received in exchange. Roman coins were circulated, but there was no native coinage. Both ships and canoes were used in navigation.

Tacitus classifies the German nations into three groups, Ingævones, Hermiones, and Istævones. These divisions are said to be named from the three sons of Mannus. The first inhabited the shores of the ocean, the second the interior, the third the south and east, but their limits are not defined.

The first distinct appearance of the Germans on the stage of classical history occurs B.C. 113, when the Teutones, a German people, appeared, along with the Cimbri, supposed to be a Celtic one, on the frontiers of Gaul, defeated the Romans in several battles, and, after the Cimbri had invaded Spain, were joined by the Ambrones, a people of Sarmatia, and continued to ravage Gaul. They were defeated by Marius near Aix (Aquæ Sextiæ) B.C. 102, when 100,000 are said to have been slain, and 80,000 or 90,000 made prisoners. A small number who escaped, about 6000, are supposed to have settled in the north of Gaul, and become the ancestors of the Ædui. In B.C. 58 Ariovistus, king of the Suevi, who had crossed the Rhine and, with an army of 120,000 Germans, had subdued the greater part of Eastern Gaul, was defeated by Cæsar, and forced to recross that river. In B.C. 55 and 54 Cæsar himself crossed the Rhine, but effected no permanent settlement. He acquired an accurate knowledge only of the tribes nearest the Rhine, the Ubii, Sicambri or Sygambri, Usipetes, and Tencteri. He enlisted Germans in his army, both against the Gauls and against Pompey. Of the Germans with whom he did not become acquainted, he was informed that they lived more by hunting and pasture than by agriculture, held their fields in com-

mon, and prevented the approach of foreign nations by devastating their borders. The civil wars diverted the attention of the Romans from Germany. The confederacy of the Sicambri made inroads into Gaul with impunity, and Agrippa transferred the Ubii, who were hard pressed by the Suevi, to the west side of the Rhine. But the Sicambri having defeated Lollius, the legate of Augustus (B.C. 16), the emperor himself hastened to the Rhine, erected fortifications along the bank of this river to oppose the progress of the enemy, and gave his step-son Drusus the chief command against them. This great general was victorious in several expeditions, and advanced as far as the Elbe. Tiberius, after him, held the chief command on the Rhine during two years, and exercised more cunning than force against the Germans. He induced them to enter the Roman service. The body-guard of Augustus was composed of Germans, and the Cheruscan Arminius was raised to the dignity of knight. Tiberius, having received the chief command a second time (A.D. 4), advanced to the Elbe. Germany had now been subdued by the successes of Drusus and Tiberius from the Rhine to the Weser, and Augustus had determined to introduce into it the regular administration of a Roman province. For this purpose he selected P. Quintilius Varus, who, in accordance with his instructions, proceeded to introduce the Roman rule; but these orders were either premature or were rashly executed. The Germans revolted under the leadership of Arminius, the Cheruscan already referred to, who had acquired a knowledge of military tactics in Rome. Besides the Cherusci, the Marsi, the Chatti, and the Bructeri joined the revolt. Arminius concocted his plans with a subtlety which speaks volumes for the vaunted fidelity of the Germans. By his recommendations the Germans obeyed all the orders of Varus, who had taken up his quarters on the banks of the Weser. Arminius and the other chiefs visited his camp on friendly terms. Varus was induced by their recommendations to divide his troops. In the meantime a distant tribe was induced to revolt. Varus marched against them, while his pretended allies went to collect their forces. He had entered the Teutoberg Forest without suspicion of danger with three legions, when he was suddenly attacked by the combined forces of the Germans, and after three days' fighting his army was almost completely destroyed (A.D. 9). He himself put an end to his life. The fortress of Aliso, erected by Drusus, to which a few had escaped, was afterwards taken and destroyed, and the Romans lost all their possessions east of the Rhine. The Cherusci now for a time became the principal nation of Germany. Germanicus, after suppressing a revolt among the legions of the Rhine, led them against the Germans, and in a succession of campaigns avenged the defeat of Varus by ravaging the country of the Marsi and the Chatti, and defeating the Cherusci under Arminius (A.D. 14–16), but he failed to recover the Roman ascendency in Western Germany. The wars which broke out among the Germans themselves, however, enabled the Romans to establish themselves in the south-west. Maroboduus, who had been sent to Rome as a hostage, and educated at the court of Augustus, at the head of some Suevian tribes had subdued or expelled the Boii, who inhabited Bohemia and part of Moravia, established the Marcomannic Kingdom, and organized the neighbouring tribes into a league for defence against the Romans, which became known as the Marcomannic Confederacy. Augustus despatched Tiberius against Maroboduus, but the revolt of the Cis-Danubian provinces compelled Tiberius to make peace with him. Afterwards the Marcomannic Confederacy excited the jealousy of the Cherusci, and a war ensued which ended (A.D. 17) in the defeat of the Marcomanni. Maroboduus besought the assistance of Rome, and Drusus was sent to mediate a peace; but in A.D. 19, upon some new offence, Drusus was preparing to invade the country of the Marcomanni, when Catualda, a chief of the Gothones, whom Maroboduus had exiled, invaded and conquered it. Catualda was himself overcome and expelled by the Hermunduri. After this the Marcomanni were for a time dependent on the Romans, although with a king of their own.

The Romans had during this period, or from about A.D. 16, commenced to establish themselves on the south-west, between the Upper Rhine and the Upper Danube. Here they formed a province called the Agri Decumates, peopled by Gauls, Germans, and Romans, and subject to tribute. It was ultimately included in Rhætia, and protected by a wall dividing it from the free Germans (see DEVIL'S WALL), but this proved an ineffectual protection against the incessant attacks to which it was subject during the decline of the empire. The Cherusci, after the loss of their great leader Arminius, A.D. 21, fell from their high rank among the German nations. Weakened by internal dissensions, they were conquered by the Chatti, who now rose into importance, and sank into an insignificant tribe to the south of the Hercynian Forest. They appear again in the Frankish Confederacy in the fourth century. The Chatti made repeated incursions across the Rhine, which it required the force of more than one Roman emperor to restrain. They were also absorbed in the Frankish Confederacy, as well as a colony of the Sicambri, which Tiberius transplanted to Gaul, and settled between the banks of the Lower Meuse and the Rhine. The Frisians, who had early entered the Roman alliance, and remained faithful to it till A.D. 28, rose and expelled the Romans in consequence of the oppression of Olennius, the Roman governor. Corbula attempted to subdue them, A.D. 47, but was recalled before he had achieved a decisive success.

The Batavi, a colony of the Chatti who left their homes in consequence of internal broils, and occupied an island at the mouth of the Rhine, became allies of the Romans, whom they furnished with soldiers, particularly cavalry. They revolted A.D. 69, in the reign of Vitellius, and were with difficulty subdued. Domitian (A.D. 84) undertook an expedition against the Chatti, and constructed a frontier wall between the free Germans and those subject to Rome. The Marcomanni had in the meantime been extending their dominion, and had come into contact with the Romans on the Danube. Domitian asked their assistance, according to treaty, in his war with the Dacians, and on their refusal went to war with them. Being defeated by the Marcomanni, he was obliged to make a humiliating peace with Decebalus, king of Dacia.

As the aggressive force of the empire abated, it continued to be more and more subject to the incursions of the Germans in Gaul, in Rhætia, in Noricum, and Pannonia. The Marcomanni were kept in check by Trajan and Hadrian, but being pressed by the migrations of other German tribes, they invaded the Roman provinces in 166, and commenced the Marcomannian war, which was continued with a short interval till 188, when Commodus purchased peace of them. After this time their inroads increased in boldness, and in the reign of Aurelian they penetrated into Italy, and reached as far as Ancona. From this time they began to decline in importance, and the last mention of them is among the hordes of Attila. Two new combinations of German tribes—the Alemanni and the Franks—began soon after the termination of the Marcomannian war to threaten the

Roman dominion on the western banks of the Rhine, and these incursions went on increasing until, by the end of the fifth century, the Germans had conquered Gaul, Italy, Spain, and part of Africa, having established a new kingdom on the ruins of Carthage. This great movement is called the migration of the nations. The Saxons, Frisians, and Angles, towards the close of this period began their invasions of Britain. After this migration Germany itself continued in a divided state till it was conquered by Charlemagne. From the establishment of the Frankish Kingdom of Clovis till the end of the Carlovingian dynasty the most important events of German history will be found in connection with the history of France.

The deposition of Charles the Fat in 887 separated Germany from France; and Arnulf, an illegitimate descendant of Charlemagne, acceeded to the crown of the former country. He was crowned emperor in 896, after a victory over Berengarius, duke of Friuli. He died in 899, and was succeeded by his infant son Louis, who was proclaimed King of Lorraine in 900, assumed the title of emperor in 908, and as such is designated Louis IV. He died in 911, and with him the German branch of the Carlovingian dynasty became extinct. The German nations, in ther general assembly or diet, chose Conrad, count or duke of Franconia, as his successor. He died in December, 918, of a wound received in battle with the Huns. In 919 Henry the Fowler, duke of Saxony, was elected. He invaded and annexed Lorraine, which was now, as afterwards, disputed between France and Germany. He extended the empire by successful wars against surrounding and less civilized peoples —the Huns, Vandals, Danes, and Bohemians—and he defeated the Hungarians, to whose incursions Germany was at this epoch subject, at Merseburg in 934. He was succeeded by his son Otto the Great in 936, who completed the conquest of Bohemia (950), invaded Lombardy, and was proclaimed King of Italy (951); after deposing Berengarius a second time, received the Italian crown at Milan (961); and revived the empire of Charlemagne, and received the crown of Holy Roman Empire from the pope, 2d February, 962. He died in 973, and was succeeded by his son Otto II., who had been crowned emperor by the pope in his father's lifetime. In 976 Otto deprived Henry of Bavaria, with whom he had been engaged in war, of his duchy. He also had a successful war with Lothaire, king of France, for the possession of Lorraine. He attempted the conquest of Calabria in 981, and held a diet at Verona in 983, at which his son Otto III. was declared his successor. He died at Rome the same year. Otto III., who was in his fourth year when he succeeded his father, was crowned by the pope in 996. He held a diet at Rome in the same year, and another at Aix-la-Chapelle in 1000. In January, 1001, he defeated the Saracens in Italy. He died in 1002. Henry II., duke of Bavaria, surnamed the Saint, the hereditary heir of the Saxon line, succeeded, after a contest with Herman, duke of Suabia, a rival claimant of the crown. He had frequent wars in Poland and Italy, and in 1022 he presided at the Council of Seligin-stadt. He died in 1024, and was canonized by Pope Eugenius II. in 1152. With him ends the Saxon line of emperors. Conrad II., surnamed the Salic, a Franconian nobleman, and a descendant in the female line of Otto the Great, was chosen to succeed him. In 1033 he succeeded to the Kingdom of Arles, which provoked a war of succession with Eudes, count of Champagne. He also spent several years in Italian wars. He died in 1039. He was succeeded by his son Henry III., who, as on former occasions, had been chosen in his lifetime. He exercised more despotic authority in Germany than any of his predecessors, setting aside the fundamental laws of the empire established by the diets. He also deposed and elected popes. His policy, which was indeed that of his predecessors more boldly pursued, if it could have been carried out would have established in Germany a hereditary monarchy. He died in 1056, and was succeeded by his son Henry IV., born in 1050. His long reign was filled with disasters, owing to the turbulence of his kingdom and his differences with the pope, in which his diets frequently sided against him. In 1073 began his famous quarrel with the pope about investitures. This great contest (see INVESTITURE), which was pursued with deadly animosity by successive pontiffs, occupied the whole of his reign and the greater part of that of his son. In the same year the Saxons revolted and involved him in a civil war. He was repeatedly excommunicated by popes, and deposed them in his turn. In 1077 Rudolph of Suabia was elected as rival emperor by the party obedient to the church, or politically opposed to the emperor. Rudolph defeated him several times in battle, but was mortally wounded in battle in 1080. Hermann of Luxemburg, chosen to succeed Rudolph, made peace with Henry in 1088. Conrad, the emperor's eldest son, next revolted, and was crowned in 1093. Henry put him under the ban of the empire, and had his second son Henry elected his successor at the Diet of Aix-la-Chapelle in 1098; but Henry was also induced to revolt by the inveterate enemies provoked by the reforms of the emperor, who was deposed in 1105, and died in the following year unabsolved by the church. Henry V., who had dethroned his father at the instigation of the pope, inherited notwithstanding the quarrel with the church about investitures. He was also engaged in wars with Hungary, Bohemia, and Flanders, in which he was frequently unsuccessful. He was excommunicated by seven councils, and his subjects were incited to revolt by the Papal legate. At length in 1122 he settled the question of investitures with the Pope Calixtus II. He died in 1125. On his death there was a contested election and a civil war between Lothaire, duke of Saxony, and Conrad of Hohenstauffen, in which the former was successful. A contest was now begun between the Saxon and Hohenstauffen (Suabian) families, in which the celebrated party names Guelf and Ghibelline originated. On the death of Lothaire in 1138 Conrad III. (of Hohenstauffen) was chosen to succeed him. The most powerful of his vassals was Henry the Proud, duke of Saxony and Bavaria. At the diet of 1138 Henry was summoned to resign one of his duchies on the plea that it was contrary to the fundamental laws of the empire for the same person to hold two. On his refusing he was deprived of both, and put under the ban of the empire. In May, 1147, Conrad set out on the Second Crusade, from which he returned in 1149. He died in 1152, and was succeeded by his nephew Frederick Barbarossa. Frederick reconciled himself with Henry the Lion, son of Henry the Proud. Conrad had already restored to him the Duchy of Saxony, and Frederick gave him back Bavaria. Frederick is celebrated for his wars, particularly for the numerous invasions of Italy, in which the greater part of his life was passed. He held numerous diets to procure means for his campaigns, and regulate the affairs of the empire. At the Diet of Würzburg in 1180 he put Henry the Lion, who had proved ungrateful to himself, and of whose tyranny there were many complaints, under the ban of the empire, and deprived him of all his estates. In 1189 he set out for Palestine, and was drowned near Seleucia, 10th June, 1190. His son Henry VI. began his reign with a war in Southern Italy. He im-

prisoned Richard I. of England, 1192–94. Like his father he was excommunicated by the pope. He conquered Sicily, and was crowned king of it in 1194. He died at Messina in 1197. Philip, brother of Henry, and Otto IV., were elected by rival factions in 1198. Philip, who was successful, was assassinated in 1208. Otto IV., the son of Henry the Lion, was recognized by the Diet of Frankfort in 1208 as the successor of Philip. After superintending the execution of severe edicts against the brigands of Germany, he passed into Italy in 1209, and occupied himself with the conquest of the Kingdom of the Two Sicilies, of which Frederick, son of the Emperor Henry VI., had been acknowledged king until 1212, when the pope having stirred up a party against him, he returned to that country, but was unable to make head against Frederick, who had been elected to replace him, and retired to his hereditary dominions, of which his rival could not deprive him. He died in 1218.

Frederick II., king of the Sicilies, was elected emperor in 1212. One of the most remarkable characters in the thirteenth century, his life passed in contentions with the popes about the Crusades, and matters connected with Italian politics. The Lombard league was renewed against him. He was repeatedly excommunicated, and though he went on a crusade, failed in all his efforts to reconcile himself with the church. He passed a severe law against heretics, and to put an end to the Guelph and Ghibelline factions in Germany, he erected the Duchy of Brunswick for the descendants of Otto (1235). The independence of the German princes was legally established in his reign. Two rival emperors were put up against him by the church party—Henry, landgrave of Thuringia, in 1246, and William, count of Holland, in 1247. He died in 1250. Conrad IV., his son, was excommunicated like his father, and had to contend against William of Holland. He died in 1254. He was the last emperor of the house of Hohenstauffen, which became extinct on the death of his son. His successor, William of Holland, was slain in Friesland in 1256. Richard, earl of Cornwall, and Alfonso X., king of Castile, were chosen emperors in 1257; but the internal divisions of Germany had already deprived the office of all authority, and neither of them had any power. Until 1273 the German Empire had no real head.

Rudolph of Hapsburg, the founder of the Austrian house, was chosen emperor in that year, and applied himself vigorously to repress the disorders to which this state of anarchy had given rise. He destroyed the castles of more than seventy robber nobles, and executed many of the criminals. He also contrived to enrich his own family by his victories over the King of Bohemia, and the recovery of the Duchy of Austria, with which he invested his son Albert. He died in 1291. Adolphus of Nassau, his successor, was deposed in 1298 by the Diet of Mentz, which alleged a heavy list of crimes against him. Albert I., son of Rodolph, was chosen emperor the same year. He is chiefly celebrated for his wars with the Swiss as Duke of Austria, which led to the independence of Switzerland. He died, 1st May, 1308, and was succeeded by Henry VII., of Luxemburg, nearly the whole of whose reign was passed in Italy, where he died in 1313. He obtained the King of Bohemia for his son. In 1314 a double election took place, Frederick, duke of Austria, sometimes called Frederick III., was elected along with Louis of Bavaria, and after a civil war was acknowledged as joint-emperor in 1325. He died in 1330. Louis V., who now became sole emperor, was engaged in constant quarrels with the popes. He died excommunicated, and deposed in 1347. Charles IV., king of Bohemia, and grandson of the Emperor Henry VII., was elected on the deposition of Louis in 1346. He was chiefly occupied with the care of his hereditary dominions, and was little respected in Germany. His reign is chiefly distinguished for the Golden Bull (1356) regulating the electorate, which is treated of elsewhere. (See ELECTOR and GOLDEN BULL.) Several rivals were opposed to him at the beginning of his reign. He died in 1378. Wenceslaus, his son, was deposed for his excesses first by the electors of the empire in 1400. Rupert, count palatine, elected 1400, possessed little authority. Sigismund, king of Hungary and Bohemia, son of Charles IV., was elected by a party in 1410, and unanimously in 1411. His reign is distinguished by the commencement of the Reformation in Bohemia, by the Council of Constance, the condemnation of Huss and Jerome, and the burning of the former in violation of the emperor's safe-conduct. He died in 1437. Albert II. (V. of Austria), son-in-law of Sigismund, was elected in 1438, and died in the following year. He was succeeded by his second cousin Frederick, duke of Styria and Carinthia, usually called Frederick III. His character was feeble and his authority small. The empire was disturbed with commotions which he hardly tried to suppress. He was engaged in war with his brother Albert for his hereditary estates, and with George Podiebrad and Matthias, kings of Bohemia and Hungary, on which kingdoms he had claims. He was also involved in the disputes between France and Burgundy. Yet he has earned the epithet of *Pacific*. He originated the famous motto of the house of Austria—*a. e. i. o. u.* (*Austriæ est imperare orbi universo*—It is Austria's part to rule over the whole world), and although unsuccessful in all his plans, he did something to justify it in marrying his son Maximilian to the heiress of Charles of Burgundy. In his reign Constantinople was taken by the Turks. He died in 1493, and was succeeded by his son Maximilian I.

The reign of Maximilian may be considered an epoch in the history of Germany. To give a connected view of the emperors up till this time we have omitted many matters of historical importance not limited to particular reigns which we shall here briefly review.

1. *Limits and Relations with other States.*—The boundaries of the German Empire cannot be given with any distinctness, both because they were continually changing, and because, particularly from the revival of the fiction of the Holy Roman Empire by Otto I., they were never well defined. The semi-religious character of the empire, and its relations with the head of the church, gave it a claim of superiority over other Christian states, and even independent nations were not always free of a suspicion of the validity of this claim, while the German diets were apt to claim authority where they had no power. At the time of the disruption of the empire of Charlemagne there were besides many conflicting feudal claims, and these were, as long as the feudal tenure remained in force, continually increased by the vicissitudes of war and alliances. This element of uncertainty common to all states operated most powerfully in Germany from the number of independent principalities composing the empire, which was liable to be increased or diminished by the successes or reverses of its members as well as of its head, who often possessed little real power, and whose claims were thus often dependent on the weakness or strength of the vassal over whom they were asserted. We shall therefore deal here only very generally with the limits of the empire, referring for further information to BELGIUM, BOHEMIA, DENMARK, FRANCE, HUNGARY, ITALY, SWITZERLAND, &c where the temporary or perman-

ent claims asserted over these countries will be more fully detailed.

On its separation from France Germany was much more restricted on its northern, eastern, and southern frontiers than in modern times. These were occupied by nations less civilized, to whose incursions the German states were liable, as the Roman provinces had formerly been to theirs. Henry the Fowler and the Ottos added the marches of Austria and Misnia to the empire, and their successors made further conquests. Mecklenberg and Pomerania were subdued in the reign of Frederick I. by Henry the Lion and Albert of Brandenburg, surnamed the *Bear*, and afterwards became duchies. The house of Austria added Styria, Carinthia, Carniola, and the Tyrol; it had lost Switzerland, and had at the time we have reached acquired through Maximilian fresh claims on Burgundy and the Netherlands. The empire early had extensive claims in France. Arnulf acquired the Kingdom of Lorraine, which had belonged to the ancient Kingdom of Austrasia, and which formed a constant subject of contention between France and Germany. The Kingdom of Arles, containing the county of Provence and Transjurane or Upper Burgundy, already a fief of the empire, was acquired as a hereditary possession by the Emperor Conrad I., and in the time of Conrad II. Franche Comté, Dauphiné, the Lyonnais, Provence, Savoy, and part of Switzerland, were included in the empire. The consolidation of the French monarchy by the acquisition of the Burgundian possessions was the work of Louis XI. Denmark and Poland owned allegiance for Jutland and Silesia up to the middle of the fourteenth century. Bohemia early became permanently connected with the empire, and its king was one of the high officers of the empire, and held the electorate. Hungary also became early associated with the empire, and like Bohemia ultimately became the inheritance of the house of Austria. Nearly the whole of Italy had at times become subject to the emperors, and their superiority was recognized by most of the Italian cities. This, as we have seen, brought them into violent contentions with the popes, and the Papal and imperial factions in the Italian cities acquired during the Hohenstauffen dynasty the names of Guelf and Ghibelline. The Lombard league formed against Frederick I. and Frederick II. indicates the power of the former faction.

Internal Divisions and Government of the Empire.—At the extinction of the Carlovingian dynasty Germany was divided into five nations or dukedoms—Franconia, Suabia, Bavaria, Saxony, and Lorraine, the last occupying the left bank of the Rhine. Besides the territory subject to these dukedoms, there were extensive domains in all parts of the empire, and on both sides of the Rhine, including the territories afterwards subject to the ecclesiastical electors, and the Palatinate, directly subject to the crown. This imperial domain was deemed so ample to support the dignity of the crown that it was the constitutional usage for each emperor on his election to grant away his hereditary estates to some member of his family. But as in France the gradual alienation of the imperial domain was one of the chief causes of the decline of the Carlovingian dynasty, so in Germany the same cause wrought an important change in the constitution and in the position and power of the heads of the empire. It is hardly necessary to seek the particular causes of the alienation of the domain in Germany. When the whole territory is not equally subject to the head of the state there must always in the exigencies of government arise sufficient motives for alienating the portions directly dependent. These can only be replaced by confiscations, the retention of which by the head of the state will be sure to cause jealousies, which a weak government does not provoke. In the circumstances of the empire in its earlier ages there were ample opportunities for alienation. In the reign of Frederick II. in particular, and during the interregnum which followed the fall of the Hohenstauffen dynasty, the whole territory of Germany became practically independent of the head of the empire, so that even the vassals of a house which like that of Hohenstauffen had become extinct, in becoming immediate vassals of the crown, held their possessions, however unimportant, by a tenure as independent as that of the most powerful princes. This change in the position of the head of the state made the constitutional usage which required the resignation by an emperor elect of his hereditary estates cease to be practicable or expedient. The most powerful princes of Germany, or the countries connected with it, were usually chosen to the imperial dignity. They retained their hereditary possessions, in which, when not engaged in war for the extension of their dominion, they usually resided. Thus the affairs of Germany became subordinate to the aggrandizement of a particular house, and the other princes became more confirmed in the policy of restricting a power which not only interfered with their independence, but was directly employed in promoting the schemes of their rivals. This change took place on the election of Louis V., who retained his hereditary dukedom of Bavaria.

Each of the original dukedoms of Germany contained a feudal nobility nearly as independent of their head as he was of the emperor. The nobles next in rank to the dukes, who were called princes, were constituent members of the diet. The counts of the empire, and even the untitled nobility, a large class, possessed privileges incompatible with the centralization of the government. Each dukedom or principality, when it became independent, had its own states, which had the power of making laws within its own jurisdiction. The dukedoms and counties, having been originally administrative offices of government, were not at first divisible; but as the division of heritable property among children prevailed in Germany, they first became hereditary, and then fell in with the national custom. Even the electoral territories were thus divided until their further alienation from the electoral dignity was forbidden by the Golden Bull. Two of the original duchies, Franconia and Suabia, became extinct by the thirteenth century. Others were created in the course of conquest; but by the beginning of this century, if not previously, the custom of the division of hereditary fiefs began to prevail. Sometimes the division was absolute. Ultimately it became common, to prevent the fiefs escheating to the empire, that each branch should have the right of reversion to the estates of the other. The Duchy of Saxony was so subdivided that the electorate was attached to the small territory pertaining to the town of Wittenberg. The natural consequence of this subdivision was to increase the number of independent principalities. On the extinction of the two great ducal houses many towns and great numbers even of the lesser nobility became immediate vassals of the empire. This disruption and dissolution of authority was a source of endless confusion. The different states formed their own alliances, and made war and peace at their own instance. Their right to do so was admitted in the time of Frederick I., and in the reign of Frederick II. the princes, practically independent, acquired a formal charter of independence. But this was not all. Even nobles who possessed a castle made predatory war on their own account, while the emperor, absent perhaps during the greater part of his reign in Italy, or engaged in civil war on his own account,

had neither means nor interest to check their lawlessness. Thus an abuse of feudalism, which often appeared on a small scale elsewhere, expanded without bounds and endured for many centuries even up to the time of the Reformation in Germany. These robber nobles abounded, especially in Franconia. The diets were constantly occupied with expedients for alleviating the disorders resulting from this state of anarchy, and often proclaimed peaces which they had not the means of enforcing.

Another peculiar result of the want of central authority was the position of the great dignities of the church. Everywhere in Europe the church acquired great possessions; but the holders of these possessions in Germany, not only the ecclesiastical electors, but bishops and abbots, became like the head of the church himself temporal princes, and were often much more occupied with temporal politics than with the affairs of religion.

The electorate, which has been repeatedly alluded to, has already been discussed in our article ELECTOR.

Cities.—One of the most interesting chapters of German history is the rise of the cities, which, amid all the confusion of the political relations of the country, made steady progress, and if they did not rival the cities of Italy in commercial importance excelled them in the steadfastness of their adherence to the cause of freedom and constitutional government. From an early period—the exact time is not known—the cities of Germany were represented in the diet. In the tenth century they were divided into mediate and immediate, or such as were included in the territories of dukes or counts, and such as were directly dependent on the empire. The former were generally represented, along with the feudal vassals, in the provincial states, the latter were generally governed by a bishop as imperial vicar. In early times they generally supported the authority of the emperor, as their interest was common with his in diminishing the power of the greater vassals. Henry V., or a diet in his reign, enfranchised the inferior townsmen or artisans, who had previously been distinguished from the upper class of citizens or burgesses, and burdened with oppressive usages. The cities were somewhat late of acquiring municipal privileges. Municipalities were at first established about the reign of Frederick I. as assistants to the imperial or episcopal bailiff. They soon began to assert their independence, and often expelled the bailiff by force. The predatory habits of the nobles, besides the claims of superiority over entire cities or particular citizens asserted by the princes, involved the cities in continual warfare with the feudal nobility, and often also with their ecclesiastical superiors. Between the city walls and the palisades bounding their territory the cities granted a refuge to all vassals who fled to them from the oppression of their superiors. These were called pfahlbürgers. This refuge was repeatedly forbidden by the diets, particularly by the Golden Bull, as an encroachment on the rights of the nobility. But the diets could not enforce their prohibition, and it was not the interest of the cities to obey it. The cities had also ausbürgers, or persons who, without residence, were granted the privilege of citizenship, and protected against the payment of feudal dues.

The necessity of defending their privileges, and the desire sometimes of asserting rights which did not belong to them, compelled the cities to enter into leagues among themselves, which soon became extensive and formidable. Among the earliest of these combinations was the Hanseatic League, formed to resist both the oppression of rulers and the depredations of land and sea robbers. A league was formed in 1255 by more than sixty cities of the Rhine, headed by the three ecclesiastical electors, to resist the depredations of the lesser nobles. The Suabian League, formed in 1376, was of similar origin. These leagues were met by counter-associations of nobles and princes.

Diets.—The German diets have been traced to those great assemblies of the different states of their kingdoms held by Charlemagne and his successors, called Champs-de-Mars and Champs-de-Mai. These again go back through the Merovingian dynasty to the ancient free assemblies of the Franks and other German tribes. In the diet of Charlemagne at Aix-la-Chapelle the bishops, with their priests and deacons, the abbots with their monks, and the emperor with the dukes and counts, formed three distinct bodies. The clerical bodies attended to the affairs of the church; in the political assembly, presided over by Charlemagne, codes compiled from the customs and laws of the different nations, Salian, Ripuarian, Saxon, Bavarian, Alemannian, &c., were promulgated, while the project of a general law for the empire was announced. The luxury and dissipation of the clergy, both regular and secular, was already a standing subject of complaint.

The exact constitution of the early German diets or their mode of transacting business is not known. In the twelfth century the counts of the empire became distinguished from the princes, and lost the right of voting in the diets. The election of an emperor was at first undertaken by the whole diet, but whether the members voted individually, by nations, or according to any other method, is not determined. The right of prætaxation, that is the right possessed by a few of nominating the person proposed for the choice of the whole electors, is first noticed in the election of Lothaire, which was intrusted to ten persons chosen by the diet. Neither the time nor the place of meeting of the diets were at first fixed. They were called by the emperor at his own pleasure, but as they had the power of granting supplies their meetings were frequent, and from the time of the Hohenstauffen dynasty regular. They concerned themselves generally with all the affairs of the empire, but as their authority over the different states was partial, and their policy could only be carried out by the executive force of the emperor, they must be regarded rather as a check upon or an auxiliary of the imperial policy than as an independent power in the state. The affairs of the church, and the quarrels of the emperors with the church, constantly occupied the diets, which sometimes took one side, sometimes another, in these quarrels. In the long struggle of Henry IV. on the question of investitures the diets, less enlightened than the emperor, generally sided with the pope. The diet of Forsheim in 1077, which chose Rudolph of Suabia in opposition to Henry, decided that the empire should no longer be allowed to become hereditary, but should be bestowed on the most worthy. At Goslar (1099) Henry proposed a mixed tribunal, without appeal to the pope, for trying ecclesiastical offences, but to this proposal the ecclesiastical members refused to consent. The Diet of Würzburg in 1121 proclaimed the pain of death against any one who broke the internal peace of the empire. The cities in which the diets were chiefly held during the Hohenstauffen dynasty were Mainz, Würzburg, Goslar, Bamberg, Magdeburg, Aix-la-Chapelle, Spires, and Frankfort. At the Diet of Frankfort in 1147 Conrad III. established an imperial council at Rothweil. The numerous diets assembled under Frederick Barbarossa discussed questions of peace and war, and supported the policy of the emperor. At one of these diets deputies from England appeared, and recommended to the assembly, deliberating between

the rival popes Pascal and Alexander, the ancient usage of England of refusing to allow appeals to the pope without the consent of the sovereign. The privileges of the towns also occupied the diets at this period. The Diet of Würzburg in 1168 issued a decree compelling bishops to receive consecration, the omission of that ceremony having become habitual, with a view to enable the bishops with a better conscience to devote their attention exclusively to secular affairs. The case of Henry of Saxony already referred to occupied several diets. In the reign of Frederick II. the diets were occupied in enlarging the powers of the clergy and princes, and consequently in restricting that of the emperor. That of Mainz in 1235 also granted extended privileges to the cities. In the reign of Rudolph private wars were again forbidden, and the diets sanctioned the severe measures taken by the emperor against the robber nobles. From the time of Albert I. the diets began to manifest a strong opposition to the encroachments of the Papal power. The Golden Bull occupied the diets of Nürnberg and Metz in 1356. Its provisions in regard to the electorate are referred to in our article ELECTOR. We here notice some peculiarities of this celebrated statute. It begins with a preamble, in which the seven deadly sins are personified, and enter into a colloquy with the emperor, in which they get the worst of the arguments. It contains a provision that if the electors assembled for the choice of an emperor could not come to a decision within thirty days they should be fed on bread and water till they had concluded their deliberation. The Diet of Nürnberg (1438) is of much importance, as its decrees embody the outline of a plan afterwards completed by the Diet of Worms in 1495 for giving an organized force to the empire in order to secure the execution of the laws promulgated by the diets, and especially for the preservation of internal peace. Rudolph had established a jurisdiction of arbiters, called Austrage, selected by and of equal rank with the disputants, for settling disputes between the various states. The Diet of Nürnberg made formal regulations for this tribunal. To provide for the maintenance of peace and the enforcement of the decrees of the imperial council, the empire, with the exception of the estates of the emperor the electors and the Kingdom of Bohemia, was divided into four circles, each under a director, who convoked the states of the circle, communicated to them the instructions of the emperor, and executed their decrees, and a duke, who commanded the military force, and called on each member of the circle for his contingent. In consequence of this establishment of public justice the diet considered itself able to decree the suppression of the secret tribunal of the Fem. At the Diet of Worms held in 1495, the emperor Maximilian consented to the establishment of a sovereign court called the Imperial Chamber, consisting of a chief judge chosen among the princes, and of sixteen assessors, partly nobles and partly lawyers, all to be named by the emperor with the approbation of the diet. It was to exercise the same authority with the imperial council, hitherto chosen by the emperor himself, of deciding in the last resort in disputes, whether between states or individuals, but it was no longer to accompany the emperor, and its members being really appointed by the diet, it gave that body for the first time an independent power in the state. Its president had the power of pronouncing in the emperor's name the ban of the empire. After the establishment of this tribunal the Diet of Worms proclaimed a perpetual peace. But the emperor, in consenting to its establishment, expressly reserved his own prerogative, upon which it seemed to infringe, and with the consent of the Diet of Augsburg (1500) he set up the Aulic Council in Vienna as a rival to the new tribunal. Thus the means of pacifying the empire became subsequently a cause of fresh disputes. In the diet of 1500 the empire was divided into six circles —Bavaria, Suabia, Franconia, Saxony, the Rhine, and Westphalia. Maximilian afterwards added four more, which included the imperial and electoral domains, those of Austria, Burgundy (Netherlands), Upper Saxony, and Upper Rhine. The Diet of Augsburg also established a permanent political council, composed of a committee of the states, in which the electors, secular and ecclesiastical princes, and towns were represented, and by which the personal power of the emperor was still further restricted. This council, however, soon proved unequal to the task assigned it. From the latter part of Maximilian's reign till the Peace of Westphalia in 1648 the most important subject which occupied the diets was the Lutheran Reformation and its consequences. From 1623, with the exception of a brief interval when they assembled at Frankfort, the diets met regularly at Ratisbon, and became gradually more subservient to the emperors. The power of the house of Austria had at last so overshadowed that of the other German houses that even the election of an emperor became merely the formal nomination of the head of that house.

Maximilian succeeded to the empire in 1493, as already mentioned. In 1496 his son Philip married Joanna, the daughter of Ferdinand and Isabella of Spain. By his own marriage with Mary of Burgundy he brought the Netherlands again into close relationship with the empire, and revived claims on Burgundy, which he was unable to maintain against the rising power of France. The French monarchy, consolidated by Louis XI., had already entered on the sphere of European politics, and with the invasion of Italy by Charles VIII. in 1494 had begun that contest for supremacy with the rival power of Germany, which, whether in the form of a conflict between rival monarchies, or of a deadlier struggle between opposed nationalities, has continued to the present day, and seems yet undetermined. Maximilian invaded Burgundy in 1498, but was compelled to submit his claims to arbitration. With the support of the diet he also endeavoured to revive the claims of the empire on Switzerland, and reduce it under the authority of the newly created Imperial Chamber. A bloody war ensued in 1499, in which he was defeated and compelled to make peace. He was constantly frustrated in his wars by want of means to keep his armies together. France, Spain, and Germany, after struggling and intriguing with alternate success for the supremacy in Italy, united in 1508 with the pope in the celebrated League of Cambrai against Venice. Maximilian abandoned this league in 1511 to enter into another, fomented by the pope, and hence called the Holy League, with Spain and England against France. About the same time he made a curious attempt to get himself on the next vacancy elected pope. In 1516 he invaded Italy, but the insubordination of his troops for want of pay compelled him to make an ignominious flight. In 1518 the affairs of Luther were first brought before the Diet of Augsburg. Maximilian died in 1519. He was succeeded by his grandson, Charles V., who had inherited the crown of Spain through his mother, and thus united under his sway a great part of Europe with the rich possessions of Spain in the New World.

The reign of Charles, the most important in the German annals, and the most brilliant in the sixteenth century, was divided among three great conflicts—the continued struggle between France and

Germany; the conflict with the Turks, whose encroachments threatened the hereditary dominions of the house of Austria; and the Kingdom of Hungary, which, together with Bohemia, fell after the death of Louis II. at the battle of Mohacz to the emperor's brother Ferdinand; and the conflict with the Reformation. In the first of these Charles enjoyed his most brilliant successes, particularly in the victory of Pavia (1525), which made Francis I. his prisoner; but Charles' seeming preponderance of power was very nearly balanced by the more central position of France and the more available character of her resources, and after all his successes he only succeeded in bequeathing to his son Philip of Spain an unfinished war, suspended by a truce which left France in possession of Savoy and the frontier fortresses of Metz, Toul, and Verdun. The material results of this struggle in the various treaties with France which resulted from it will be found in our history of that country, and its various incidents and episodes, the alliances of both kings with England, the defection of Bourbon, the emperor's quarrel with Clement VII., the sack of Rome, in the respective biographies. The war with the Turks became formidable, when, after his victory at Mohacz (1526), Solyman set up a king of Hungary, and laid siege to Vienna (1529); and his repeated invasions of Hungary and alliances with France continued to harrass the empire till the close of Charles' reign. This war also had its episodes in the naval expeditions of Doria and the emperor to Tunis (1535) and Algiers (1541). But the most important feature of Charles' reign was the struggle with the Reformation, and in it he can be credited with neither glory nor success. It cannot be disguised that his policy with the Reformers was tortuous. When his foreign policy required it, and particularly when pressed by the Turks, he made concessions freely; but when, with the active assistance of the Reformers, he had been relieved from this danger, and had been left at liberty by the Peace of Crespy (1545) to attend to the internal affairs of the empire, he speedily withdrew his concessions. The League of Schmalkalden, with which the emperor had concluded the Peace of Nürnberg in 1532, through the bad generalship and divided counsels which are inherent in such combinations, suffered a decisive defeat at Mülhberg in 1547; but Charles was not yet wholly master of the situation, and the famous Interim of the Diet of Augsburg in 1548 was the fruit of his victory. But this success was dearly purchased. Maurice, whom he had made elector of Saxony, put himself at the head of a new league, which did not commit the faults of its predecessor, and extorted the Treaty of Passau in 1552, by which the whole policy of the emperor's reign was overturned, and the liberty of Protestant worship secured. In 1554 Charles negotiated the marriage of his son Philip with Mary of England. The Treaty of Passau had provided for referring the religious disputes to a diet, and at the Diet of Augsburg in 1555 a Religious Peace was negotiated by Ferdinand, the emperor's brother. It contained two provisions, which ultimately aggravated existing differences, and were a main cause in promoting the Thirty Years' war. The Lutherans were then the chief body of Reformers in Germany, but the Calvinists were rapidly increasing in numbers and influence. The toleration granted by the peace was limited to the followers of the Confession of Augsburg. One of the great causes of difference between the Catholics and the Reformers was the great amount and peculiar tenure of ecclesiastical property to which we have already alluded. The secularization of this property was looked on as a profanation by the Catholics, while the Protestants could not be expected to see with complacency possessions which conferred political power and dignity to the extent of direct personal authority exclusively in the hands of their enemies. A large amount of ecclesiastical property had already been secularized through the conversion of its holders. This was in fact a powerful motive to conversion, as the church did not give hereditary possession. The Catholics now succeeded in securing an article called the Ecclesiastical Reservation, by which any holder of an ecclesiastical benefice changing his religion should forfeit the benefice. This seemingly reasonable provision excited the strenuous opposition of the Protestants, and was only permitted to pass under protest. In 1556 Charles resigned the empire to his brother Ferdinand. The Netherlands and the Italian possessions, for which so much German blood had been spilt, had already been given with the Kingdom of Spain to his son Philip. Charles retired to the monastery of St. Just in Estremadura, where he died in 1558.

The pope refused to recognize the abdication of Charles and the accession of his successor, and declared the acts of the Diet of Frankfort (in 1558), which had acknowledged Ferdinand, null and void. Ferdinand in consequence assumed the title of emperor elect, and from this time coronation by the pope was no longer deemed necessary by the German emperors. Ferdinand observed the religious peace, and was chiefly occupied with the affairs of his hereditary dominions. He succeeded in making Bohemia hereditary, and in 1562 concluded a truce for eight years with the Turks. The Council of Trent was concluded in his reign. He died in 1564. Maximilian II., son of Ferdinand, was distinguished for the moderation of his policy in regard to religion. He extended toleration to his hereditary dominions. Maximilian was in 1566 engaged in a fresh war with the Turks in Hungary, during which Soliman died from fatigues incurred, in the obscure fortress of Szigeth. Maximilian died in 1576, while he was preparing to assert his claim to the crown of Poland. His son, Rudolph II., who had been brought up at Madrid, was, in contrast to his father, a Catholic zealot, and soon rendered himself unpopular by his persecution of the Protestants, and by his complete incapacity for government. The Arch-duke Ferdinand of Styria, and Maximilian, duke of Bavaria, also distinguished themselves by their zeal for the Catholic religion. The latter procured a decree of the Aulic Council putting the free imperial city of Donauwörth under the ban of the empire, and intrusting him with its execution. The proceedings which followed, known as 'the troubles of Donauwörth,' occasioned the formation of the Protestant Union, 4th May, 1608. This was followed by a counter-association on the part of the Catholics (July, 1609), called the Holy League. A war with the Turks was favourably concluded by the Peace of Sitvatorok in 1607. In 1609 Rudolph was compelled by his Bohemian subjects to sign a *Majestätsbrief* granting complete religious liberty, which was one of the proximate causes of the Thirty Years' war. He was forced in 1608 to resign to his brother Matthias the crown of Hungary, and in 1611 that of Bohemia. He died in 1612. Matthias, who succeed him as emperor, was not a much better ruler than his brother, and Germany, under his reign, continued rapidly to become more disorganized. With the consent of his brothers he adopted his cousin, Ferdinand of Styria, as his successor, and resigned to him the crowns of Hungary and Bohemia during his lifetime. He died in 1619. Ferdinand II. was more capable than his two immediate predecessors; but his religious bigotry made his accession at this time a calamity to Germany. His Bohemian subjects were already in open revolt, and

offered the crown of Bohemia to the Elector Palatine Frederick V., who, although the Protestant Union was divided in opinion on the subject, decided to accept it. Frederick was defeated in the battle of Prague (8th November, 1620), put under the ban of the empire, and deprived of his estates, which, together with the electorate, were given to the Duke of Bavaria in 1623. These events form the commencement of the Thirty Years' war, the details of which will be found in a separate article. The invasion of Germany by Christian IV. of Denmark in 1625, the Peace of Lübeck (27th May, 1629), the invasion of Gustavus Adolphus (1630), the battles of Leipzig in 1631, of the Lech and Lützen in 1632, of Nördlingen in 1634, the war with France in 1635, belong to the history of the Thirty Years' war, and the policy of Richelieu (see RICHELIEU). The troubles of this period were increased by the edict of restitution passed in 1629, which revived the Catholic claims on all church property secularized since the Peace of Passau in 1629. Ferdinand died in 1637. His son, Ferdinand III., had gained a military reputation by the battle of Nördlingen, but he did not put it to the proof by taking the command of his armies. Baner, Frederick of Saxe-Weimar, Torstenson, Turenne, and the great Condé gained repeated victories over his troops. He was at length induced to enter into negotiations. The war, through complication with the affairs of Spain and the Netherlands, had gradually extended throughout Europe. A congress of nations was opened in the towns of Münster and Osnabrück, the Catholic powers being represented at the former and the Protestant at the latter (1643); and after some years' of fighting and negotiation the Thirty Years' war was concluded by the Peace of Westphalia (24th October, 1648), in which the policy of France and Sweden was triumphant. The principal conditions which concerned Germany were a general amnesty and restoration of rights; the Upper Palatinate was retained by Bavaria, the Lower, with a new electorate, was restored to Charles Louis, son of Frederick V.; the diets of the empire were to have the sole power of making and interpreting the laws, of levying taxes, raising troops, making treaties, and declaring war; the imperial chamber and the aulic council were to be reformed so as to give greater power to the Protestants; and the right of the princes and states to make war and alliances among themselves or with foreigners was recognized. Thus the policy of the Diets of Nürnberg, Worms, and Frankfort was defeated, and the consolidation of the German Empire frustrated, the great aim of Richelieu. The bishoprics of Metz, Toul, and Verdun, with Breisach, Upper and Lower Alsace, and ten imperial cities, were ceded to France; the independence of Switzerland was acknowledged, and the claims of the empire on the Netherlands abandoned, and some cessions of territory were made to Sweden. After the Peace of Westphalia Ferdinand continued to afford the Spaniards material assistance in their war with France. Two leagues formed in Germany after the Peace of Westphalia, called respectively the Catholic and the Protestant League, enabled France to maintain its influence in the affairs of Germany, and several of the German princes entered into the French alliance. The Peace of Westphalia was confirmed by the Diet of Ratisbon in 1654. The emperor died in 1657. His son, Leopold I., was already King of Hungary and Behemia (1655–56). He was elected emperor in 1658, although the French ambassadors, who were admitted to the electoral diet, made an effort to divert the imperial crown from the house of Austria. They succeeded in imposing, as a condition of his capitulation, that he should not assist the enemies of France in the war then in progress. Further to secure the neutrality of Germany in the war with Spain, Mazarin also succeeded by his influence with the ecclesiastical electors in combining the two leagues, Catholic and Protestant, into one, called the Rhenish League, under the protection of France, for the maintenance of the Peace of Westphalia. This league was tacitly recognized by the emperor, who received a contingent of troops from Louis XIV., as a member of it, in the Turkish campaign in 1664. The Treaty of Oliva in 1660 put an end to the war, in which Sweden, Poland, Denmark, and the Electorate of Brandenburg were more concerned than the empire. In 1668 Leopold entered into the first of the series of treaties with France in regard to the claims of both monarchs to the Spanish succession, which ended in the establishment of the Bourbons on the throne of Spain. The success of Louis XIV. in his invasion of Holland led to a coalition against him, in which the emperor, after temporizing for some time, joined (30th August, 1673). The war was continued for some years, and terminated by the Peace of Nimeguen, acceded to by the emperor on 5th February, 1679. A formidable war with the Turks broke out in 1663. Vienna, besieged in 1683, was saved by John Sobieski, king of Poland. In 1684 the Holy League was formed against the Turks with the King of Poland and the Republic of Venice, and the war was continued till 1699, and concluded by the Peace of Carlowitz, when the Turks abandoned their claims in Hungary, Transylvania, and Slavonia. The intolerance of the Austrian government and the persecution of the Protestants had caused various insurrections in Hungary, and led the Protestants even to favour the Turks, who did not molest them. In 1687 Leopold proposed to the states of Hungary to incorporate his conquests from the Turks in that kingdom, and grant religious liberty, if they would abandon their constitution and make the kingdom hereditary. This being acceded to, his son Joseph was crowned King of Hungary. The emperor, with other German princes, joined in the League of Augsburg (9th July, 1686) against Louis XIV. A protracted war, distinguished by the devastation of the palatinate, was concluded by the Peace of Ryswick, acceded to by the emperor 30th October, 1697. In 1692 the emperor erected Hanover into an electorate on terms which offended some of the German princes, and in 1700 he permitted the Elector of Brandenburg, Frederick III., to take the title of King of Prussia. The war of the Spanish Succession, in which Great Britain, Holland, and the empire, were leagued against France, was begun in 1702. The Emperor Leopold died in 1705. He was succeeded by his son, Joseph I. At the commencement of his reign insurrections occurred in Hungary and Bavaria; the Electors of Cologne and Bavaria were put under the ban of the empire; the estates of the latter were divided, and the Upper Palatinate was restored to the elector palatine. The success of the imperial arms enabled the emperor to revive the claims of his house upon Italy. Joseph died in 1711. He was succeeded by his brother, Charles VI., the claimant of the Spanish crown. The alliance against France was dissolved by the Peace of Utrecht in 1713, to which the emperor refused to accede, and was left alone against France. After a brief campaign between Prince Eugene and Villars he acceded to the Treaty of Rastadt, negotiated between these commanders 7th March, 1714, on his own behalf, and on behalf of the empire at Baden, 7th September, 1714. The Spanish Netherlands, and Naples, Milan, Sardinia, and other Italian conquests, were left to the emperor. By the Barrier Treaty (15th November, 1715), between the emperor and the states-general of the United Provinces, an arrangement was made for the joint garrisoning of

the fortresses of Namur, Tournai, Ypres, &c. A short war against the Turks, conducted by Prince Eugene, ended by the Peace of Passarowitz (July 21, 1718) in further acquisitions to the hereditary possessions of Austria. The quadruple alliance formed by England, France, Austria, and the United Provinces (1718–19) against Spain provided for mutual renunciations on the part of Philip V. and the emperor of their respective claims on Spain and the Netherlands, and a readjustment of possessions in Italy, where war had already broken out between them. Spain acceded to the alliance, after a brief resistance, in 1720. Its most important consequence was the erection of the Kingdom of Sardinia under Victor Amadeus II. of Savoy. The emperor having no male heirs had promulgated in 1713 the pragmatic sanction regulating the succession to his hereditary dominions in favour of his daughters in preference to those of his brother, Joseph I. This was acceded to by the states of Austria in 1719, and afterwards by the other hereditary states, and having been subsequently guaranteed by England, Holland, Spain, and France, eventually led to the war of the Austrian Succession. A disputed succession to Poland led to a war between France and Austria in 1733, in which the French attacked the Italian provinces of the emperor and invaded Germany. Peace was concluded at Vienna 18th November, 1738, by which the emperor lost Naples and Sicily and part of his possessions in Northern Italy, and acquired the Duchy of Parma, while the Duke of Lorraine, who was to marry his daughter, Maria Theresa, received the Archduchy of Tuscany in exchange for his own duchy, and France guaranteed the pragmatic sanction. In 1737 the emperor joined Russia in a war with the Turks. Peace was concluded in 1739 on unfavourable terms, Austria surrendering Belgrade and agreeing to evacuate Servia and Walachia. The emperor died in 1740. Charles Albert, elector of Bavaria, son-in-law of Leopold I., was chosen emperor in 1742, and crowned with the title of Charles VII. He laid claim to the hereditary possessions of the house of Austria, and had already occupied Bohemia and been crowned king of that kingdom in 1741. He had also entered into an alliance with France, Spain, Prussia, &c. (Treaty of Nymphenburg), against the claims of Maria Theresa, who was supported by England, Holland, Poland, &c., called the Alliance of Hanover. Thus was begun the war of the Austrian Succession (see AUSTRIA). Charles VII. was speedily driven out of Bohemia, and lost even his hereditary states of Bavaria, which Marshal Seckendorf recovered for him. He died at Münich in January, 1745. Francis I., grand-duke of Tuscany, the husband of Maria Theresa, was elected emperor at Frankfort on 13th September, and thus the house of Hapsburg-Lorraine, which had succeeded to the hereditary possessions of Austria, was recognized as the head of the empire. The war of Succession was concluded by the Treaty of Aix-la-Chapelle (October 18, 1748), to which the emperor was not a party, although the empire lost by it some of its Italian fiefs. The chief result of the war was the annexation of Silesia to Prussia. This peace was followed after a brief interval by the Seven Years' war (1756–63), excited by the desire of Maria Theresa to recover Silesia, in which war Austria, Russia, and France, with Saxony and other powers, combined together against Prussia. This war was concluded by the Peace of Hubertsburg (15th Feb. 1763), in which the empire was included. Prussia retained her acquisitions, and Frederick II. agreed to support the election of the eldest son of Maria Theresa as King of the Romans. The death (in 1765) of Francis I., who had exercised little influence on political events, led to the succession of this prince as Joseph II. He was of an active and reforming disposition. He joined with Russia and Prussia in the first partition of Poland (1772). The Bavarian line having become extinct, the elector palatine succeeded to it after a war terminated by the Peace of Teschin (13th May, 1779). Maria Theresa died in 1780, and Joseph succeeded to the Austrian dominions, of which he had been co-regent since 1765. In 1781 he put an end to the Barrier Treaty, and razed the fortresses which the Dutch were entitled by it to occupy. In the same year he issued a decree abolishing monastic orders and making other ecclesiastical reforms, and also an edict of religious toleration. These reforms, which procured him the title of the *philosophic emperor*, caused much discontent to his Catholic subjects, and, together with other grievances, caused a revolt in the Netherlands (see BELGIUM), which was not suppressed till after his death, which occurred in February, 1790. He was succeeded by his brother Leopold. His domestic policy was reactionary, and he joined with Frederick William II. of Prussia in the celebrated Declaration of Pilnitz (27th August, 1791) against the promoters of the French revolution. He died 1st March, 1792, and was succeeded by his son, Francis II. Francis confirmed the alliance of his father with Prussia, and was immediately involved in war with France. He joined in 1793 in the second partition of Poland. He took the command of his army against the French in 1794, concluded the Peace of Campo Formio with Bonaparte (17th October, 1797); joined the second coalition against France in 1799, and concluded the Treaty of Lunéville (3d February, 1801); joined the third coalition in 1805, and concluded the Treaty of Presburg (26th December, 1805). The results of these treaties will be found in our History of France. In 1804 Francis took the title of hereditary Emperor of Austria, and after the Peace of Presburg, the German Empire having been virtually dissolved by the Confederation of the Rhine, he renounced on 6th August, 1806, the title of its head. From this period till 1815 there is no united history of Germany.

The States of Germany were again united by the Treaty of Vienna (1815), in a confederation called the German Confederation (der Deutsche Bund); its proceedings, however, possessed for a time very little interest or importance. In 1818 a general commercial league, called the Zollverein, was projected by Prussia, and was gradually joined by most of the German states except Austria. (See ZOLLVEREIN.) Germany had, during the French revolution, imbibed liberal ideas, which caused frequent troubles in the different states, and more general outbreaks in 1830 and 1848. In the latter year the confederation underwent a revolution, and a constituent assembly was substituted for the diet. The diet was re-established in 1851. A reform of the confederation, proposed by Austria in 1863, and accepted by the diet, was rejected by Prussia. In 1866 the majority of the diet supported Austria in her dispute with Prussia respecting the disposal of the duchies of Schleswig and Holstein, which had been jointly occupied under the authority of the confederation, whereupon Prussia withdrew from the confederation, and declared it dissolved. The Seven Weeks' war between Austria and Prussia ended in the defeat of the former, the loss of her Italian possessions, and her exclusion from the German Confederation, which was re-formed by Prussia under the title of the North German Confederation. Peace was signed at Prague between Austria and Prussia on 23d August, 1866. Secret treaties of alliance had previously been entered into between Prussia and Würtemberg (13th August), Baden (18th August), and Bavaria (22d August). These were made

public on 23rd March, 1867. The next great event was the war with France, which arose out of an offer of the crown of Spain to a Prussian prince (see FRANCO-GERMAN WAR), and resulted in the triumph of the German arms. In this great struggle the South German States, as well as the North German, supported Prussia. When the result of the war was no longer doubtful, the King of Prussia was invited to assume the title of German Emperor, and he was accordingly proclaimed at Versailles on 18th January, 1871. The parliament of the new German empire met at Berlin on 21st March, and the constitution was adopted. The Emperor William I. died on March 9th, 1888, and was succeeded by his son Frederick, who died on June 15th of the same year. Frederick's elder surviving son then ascended the imperial throne as William II., and has shown himself to be a monarch with a mind and will of his own, and a man of striking and somewhat peculiar personality.

The consolidation of the German empire was largely the work of Prince Bismarck, who became the first Imperial Chancellor. He successfully sought to secure Germany from attack, so as to enable her to develop her industries in peace, partly by the maintenance of a powerful, well-trained army, and partly by alliances with other powers. In 1879 he formed an alliance with Austria, and three years later with Italy. This Triple Alliance, as it is called, has been renewed in several subsequent years. During the earlier years of the reconstituted empire he was engaged, with the support of the powerful National Liberal party, in a contest with the papacy regarding the relations between the Imperial Government and the Roman Catholic religious societies of Germany. The Jesuits and similar orders were expelled in 1872, and a law was passed in 1874 making marriage a civil contract; but in 1880 and the years immediately following, he found it expedient to open negotiations with papal representatives. Ultimately he admitted defeat by practically repealing the 'Falk laws', as the anti-papal legislation was called, after a Prussian minister of worship, and with this repeal the long so-called 'Kulturkampf' ended. It was Bismarck who in 1884 inaugurated German colonial development by declaring a protectorate over territories in the south-west of Africa. Since then Germany has acquired Togoland, the Cameroon region, German East Africa, part of New Guinea, the Marshall, Caroline, Pelew, and other island groups in the Pacific, besides the most important of the Samoan Islands. In his campaign against social democracy, which has become an important factor in German politics, Bismarck did not rely exclusively on force and repression. He sought to destroy the social discontent, in which much of the strength of Socialism lay, by passing measures intended to improve the condition of the working-classes. In this respect his policy has also been maintained to the present time. Bismarck retired from all his high offices in 1890.

Probably the most striking feature in the recent history of Germany is the rapid development of its manufacturing industries and its foreign trade. The mercantile navy is steadily growing in size and importance, and the emperor has recently induced the Reichstag to vote large amounts for the increase of the war navy. The seizure by Germany of the port of Kiao-Chow in China was undoubtedly the immediate cause of the troubles that recently brought that country into conflict with the European powers, and her ill-advised aggressiveness has thus led to the present position of Russia in Manchuria.

German Language.—The German language, called by the Germans themselves *Deutsch* or *Die deutsche Sprache*, is one of a group or family of allied tongues known by the name of Teutonic or Germanic, and including English (Anglo-Saxon), Dutch, Danish, Icelandic, Swedish, and Gothic; to which may be added, as of less importance, and having more the character of dialects, Norwegian, Frisian, Platt-deutsch (the vernacular of the North German lowlands), and Flemish, which differs little from Dutch. It is also distinguished as High German, being originally the language of the more inland and elevated parts of Germany. Three chief periods are usually distinguished in the history of the language—those of the Old, the Middle, and the New High German—the last being the ordinary literary German of the present time. Old German is known by monuments of the seventh century, when it was split up into three divisions: Upper German among the Alemanni, Bavarians, and Longobards; Low German among the Frisians, Saxons, and Westphalians; and a middle group in Hesse, Thuringia, and Franconia. The eastern part of Germany was at that time occupied by Slavic tribes. The Franconian dialect prevailed during the reign of Charlemagne and for some time after; the Longobardic early fell into disuse.

Middle High German became literary in the twelfth century, its poetry giving it a predominance over a wide area. It was surpassed during the following year by the Suabian, which had a still wider field. Other idioms attempted to rival these two, but in all the writings of the fourteenth and fifteenth centuries the Suabian influence is apparent. The Low German Sachsenspiegel, and other law books, were translated into Upper Saxon, which at last became the language of literature and cultivated society in Germany, in consequence of the translation of the Bible by Luther. Luther's translation may be said to having settled the High German as a literary language upon a fixed and permanent basis. The language was afterwards much corrupted by admixtures from foreign languages, especially during the Thirty Years' war, which deluged Germany with hosts of mercenaries from all parts of Europe; but the great writers of the eighteenth and nineteenth centuries—poets, historians, philosophers, critics, &c.—have brought it to its present eminence. Although wanting the precision and clearness of the French, the soft music of the Italian, and the flexibility and grammatical simplicity of the English, yet it has acquired a majesty, energy, and charm of its own, and the German translators of Homer, Dante, and Shakspere have reproduced the thoughts of the original with a force and fidelity unrivalled in any other language.

German Literature.—Literature in Germany received its first impulse from the fondness of the Germanic races for celebrating the deeds of their gods and heroes. Of these early songs in praise of the gods Tuisco and Mann, and of the hero Arminius, who conquered the Romans in the great battle in the Teutoburger Forest in the ninth year of the present era, nothing even in a translated form has been handed down to us. The legends immediately connected with the Gothic, Frankish, and Burgundian warriors of the period of national migration—the Dietrich (Theodoric) and Siegfried-Sagen, the Hildebrandlied, &c.—have for the most part some historical foundation, and many of them were eventually incorporated in the Nibelungenlied, the most celebrated production of German mediæval poetry. On the introduction of Christianity literary activity really began. The British missionaries established cloisters and brotherhoods in Germany between the sixth and eighth centuries, and laid the foundation for that system of education which was most

fully developed under the fostering care of Charlemagne. Metrical translations of the Evangelists appeared in the ninth century in the High and Low German dialects; the Krist of the High German in rhyme, the Heliand in the other idiom, preserving the ancient alliterative form of verse. One of the best specimens of Old High German literature is a translation of the Psalms by Notker about the same period. The Ludwigslied, a pæan in honour of the victory of Louis III., king of the Franks, over the Normans in 883, which Herder extols as one of the best specimens of early German poetry, was composed in Old High German by a Frankish ecclesiastic. The preservation of the Hildebrandlied is also due to churchmen, who transmitted it partly in the high and partly in the low forms of the dialect. Several Latin hymns, too, were based on Hunnish and Burgundian legends and the 'beast-fables' (Thiersage); but with these exceptions the clergy were generally opposed to the national poetry, on account of its pagan associations.

In the twelfth and thirteenth centuries poetry passed from the monasteries and ecclesiastical schools to the palaces of princes and the castles of nobles. The deeds and tales of the Crusaders, the fresh bloom of chivalry, the lays of the troubadours and the trouvères of Provence and Normandy, had a powerful influence on the spirit, form, and language of German poetry. Many of the poets of this period were nobles by birth, some of them even princes. Heinrich von Weldeke was the first to introduce into his heroic poem Eneit (composed, it is said, after a French translation of Virgil) that spirit of devotion to women called by the old Germans *Minne* (Love, hence the name *Minnesänger*, Love-Minstrel). Weldeke is considered the originator of the heroic minstrel songs, but he is far surpassed by Wolfram von Eschenbach, the author of Parzival, and the unfinished epics Titurel and Wilhelm von Oranse. In the first-mentioned poem are embodied the legends of King Arthur, the Knights of the Round Table, and the San Graal (Holy Grail). These traditions, together with the exploits of Charlemagne, of Alexander the Great, and the Trojan heroes, inspired also the lays of Gottfried of Strasburg, Herbort von Fritzlar, Hartman von der Aue, and Konrad of Würzburg. The love songs of this period breathe a purer and more reverential devotion to woman than the songs of the French troubadours. A species of lay peculiar to this time (called *Wächtlied*, watch-song) consists of a dialogue between a lover and the sentinel who guards his mistress. The inventor, or at least the most gifted author in this department of lyric poetry, is Walter von der Vogelweide, the victor in the poetic war of the Wartburg. Next to him rank Heinrich von Ofterdingen, Reimer der Alte, Heinrich von Morungen, Gottfried von Nerfen, and the Austrian bards Nithard and Tanhäuser. Several hundreds of these poets were engaged in travelling from palace to palace, and from castle to castle. Their songs were mostly in the Suabian dialect, and the poets constituted what is called the Suabian school, which may be said to have risen and fallen with the Suabian emperors of the house of Hohenstauffen (1138–1254). The crowning event of this era was the appearance of the Nibelungenlied (about 1210), the greatest of the Old German epics. The origin of this poem is a subject of as much controversy as that of the Iliad and Odyssey. Some will have it that the poem is but a series of popular ballads strung clumsily together, without the slightest alteration, by some obscure personage; others will have it that the first part, Siegfried's Tod, was the production of one author, and the second part, Kriemhilden's Rache, that of another; while again a third authority asserts it to be the work of one hand. It was closely followed by a not unworthy successor, Gudrun, and by the Helden-Buch (Book of Heroes), which consists of a collection of fragmentary pieces treating of the same legends as the Nibelungenlied, but mixed up with tales of the Crusaders. In the thirteenth century didactic poetry began to be cultivated with some success; the dawn of historical literature is heralded by several local chronicles. Ulrich von Lichtenstein deplores, in his poem Frauendienst (1275), the decline of chivalry, but his attempt to revive its spirit was hopeless. In the troublous times of the Interregnum (1256–73) the gay and gallant knights degenerated into little else than gloomy robber chiefs; and poetry passed from their abodes to the homes of the private citizen and the workshops of the shoemaker and weaver. These plebeian songsters formed themselves into guilds in the imperial cities—Nürnberg, Frankfort, Strasburg, Mainz, &c., and were called *Meistersänger*, in contradistinction to the knightly *Minnesänger*. In the fourteenth century Germany produced several mystical theologians, disciples of Meister Eckhart, the most celebrated of whom were Tauler and Suso, whose sermons and writings paved the way, in some measure, for the Reformation. The last echoes of the chivalric lays were two allegorical romances, Theuerdank (in verse) and Weisskunig (in prose), written in great part, if not wholly, by the Emperor Maximilian I., and transcribed and perhaps polished by his private secretary, Melchior Pfinzing. An important event of the fourteenth century was the foundation of the University of Prague (1348), soon after followed by similar establishments throughout the length and breadth of the empire. The only good poets in the fourteenth, and up to the close of the fifteenth century, were the spirited lays of Halb Suter and Veit Weber, who celebrated the victories of Switzerland over Austria and Burgundy. Classical culture was greatly furthered by the establishment of Deventer University in 1400 by Gerhard Groot, and of many schools in imitation of it in Germany and the Low Countries. Among the students were Hegius, Reuchlin, and Agricola. Peurbach was the first restorer of mathematical science, and his pupil Regiomontanus (Johann Müller) was the greatest mathematician of the fifteenth century. The invention of printing caused a still increasing literary activity, and the works printed in Germany between 1470 and 1500 amounted to several thousand editions. In 1498 there was published the celebrated beast-epic Reineke Vos (Reynard the Fox), which, according to Jakob Grimm, originated with the Frankish tribes, who carried it with them when they crossed the Rhine and founded an empire in Gaul, and from whom it was diffused among the neighbouring tribes of Northern France and Flanders. The sixteenth century opens with the foundation of the University of Wittenberg (1502), and, along with the Reformation, inaugurates a new era in literature by Luther's translation of the Bible. The Misnian dialect as used by him is so pure, harmonious, and beautiful that all the other dialects, which had until then alternately predominated in German composition, were from this time gradually banished from literature, and the idiom of the Bible (now known as the Neu Hochdeutsch (New High German) has now become the sole medium of intercourse in cultivated society in the empire. Besides his translation of the Scriptures, Luther (born 1483, died 1546) enriched the national literature with many religious songs, many of which have become classical, and have found hosts of imitators, the most successful of whom were Decius and Speratus, and in the seventeenth century Gerhard. Michael Weiss translated the hymns of Huss into German. The writings of Luther, Zwingl

(1484–1531), Sebastian Frank (1500–45?), Melancthon (1497–1560), Ulrich von Hutten (1488–1523), a remarkable anonymous treatise, Das Büchlein von der Theologie, edited by Luther himself, and other works by eminent reformers and scholars, constitute the principal theologic literature of the Reformation. History was now written in a superior style, and with greater comprehensiveness, by Frank in the Zeitbuch and Weltbuch, and by Sebastian Münster (1489–1552) in his Kosmographie; also by Tschudi (1505–72) in Chronicles of Switzerland, and by Aventinus (1477?–1534), the Bavarian chronicler. Seb. Frank published also a collection of German proverbs, which was, however, far inferior to that published under the title of Auslegung deutscher Sprüchwörter, by his predecessor Johann Agricola (1492–1566). The principal literary events in prose belles-lettres of this period is the appearance of a popular literature in the shape of Volksbücher (People's-books), in which were reproduced, in short compass, many of the ancient traditions, legends, and tales of Germany and other lands. Boccaccio, Poggio, and other Italian novelists, were also introduced by translation to the notice of German readers. The Reformation period was particularly fruitful in satirical and allegorical works. One of the most remarkable of the former kind was the Narrenschiff (Ship of Fools), by Sebastian Brandt or Brant (1458-1520), a metrical satire on the follies of the century, and which was imitated by Thomas Mürner (1476–1536) in his Narrenbeschwörung (Conjuration of Fools). Mürner was one of Luther's bitterest opponents, and wrote a coarse yet clever satire on him, Von dem grossen Lutherischen Narren (Of the great Lutheran Fool). The most talented satirical and didactic poet of the period was Johann Fischart (1545?–89), author of a romantic poem, Das glückhafte Schiff, which is regarded as a model, and numerous other works, many of them written in the Rabelaisian style. The story of Faust, of the Wandering Jew, the Autobiography of Götz von Berlichingen (afterwards celebrated by Goethe), and the comical Till Eulenspiegel, which relates the freaks and drolleries, fortunes and misfortunes, of a wandering mechanic, were amongst the most popular works of this age. At this time appeared Hans Sachs (1494–1576), the cobbler of Nürnberg, the Meister of the Meistersänger, as he is called by Herder, who excelled in all styles of composition, in tragedy, comedy, psalms, allegories, fables, tales of a religious and of a broadly comic character, &c. Frauenlob and Michael Behaim also wrote several notable poems; and Rosenblüt and Folz were tolerably successful playwrights, the former being also one of the best tale-writers of his time. The most successful rival of Sachs as a dramatist was his townsman, Jakob Ayrer (died 1605), who excelled him in the skilful arrangement of plot. Among the purely didactic fabulists were Burkard Waldis, Erasmus Alberus, and Georg Rollenhagen, the two former being also famous as composers of hymns. During the excitement occasioned by the Reformation almost all branches of literature were cultivated, but it was in learned and scientific treatises that the age was most prolific. Besides Melancthon, whose influence secured the preponderance of the Aristotelian philosophy in the Protestant schools of Germany, there were Luther, Camerarius, Cornelius Agrippa, Paracelsus, Copernicus (astronomy), Leonhard Fuchs (botany and medicine), Conrad Gesner (zoology and classics), and Agricola (mineralogy). At the close of the sixteenth century few of the great scholars were left, and classic learning was beginning to decline in the early part of the seventeenth. The universities and schools which had sprung up under the influence of the Reformation were no longer animated with the zeal of the reformers, but engrossed by subtle polemical and scholastic strifes. The deliverance of the German intellect from the scholastic bonds of the middle ages, which had been a cherished task of Luther's, was again retarded. The seventeenth century has been called, in German literature, the period of imitation. Most of the poets of this age were graduates of universities; and learned societies on the model of the Academia della Crusca were formed for the purpose of improving the language and literature. After their dissolution they were replaced by literary and scientific associations in Leipzig, Berlin, Hamburg, Halle, Königsberg, and in several other of those Protestant towns in North Germany which, greatly owing to the establishment of their universities, had become the chief centres of culture. A new school of poetry was founded, of which Martin Opitz (1597–1639) was the leader. His works are more remarkable for smoothness of versification and an occasional felicity of expression than for true poetic inspiration; but they exerted a healthy influence at a time when the Thirty Years' war and the growing taste for inferior French and Italian compositions threatened to annihilate all vestiges of pure German poetry, and when the reforms introduced by Luther into the language still required to be insisted upon. This first Silesian school, as it was called, after the birth-place of its chief, counted among its members many ingenious writers, as Simon Dach (1605-69), Von Zesen (1619–89), Johann Rist (1607–67), and, greatest of all, Paul Fleming (1609–40), whose lyrics are natural and cheerful as the songs of a lark. Equally great, but totally different in disposition, was the leader of the second Silesian school, Andreas Gryphius (1616–64), who, besides being the author of many passionate yet melancholy poems, may be looked upon as the founder of the modern German drama. In poetry and in the drama Gryphius had several imitators, the principal being Lohenstein (1635–83), whose tragedies teem with slaughter and pompous phrases; Christian Weise (1642–1708), a comedian of infinite humour, though sometimes of a rough sort; and Hoffmann von Hoffmannswaldau (1618–89), Asman von Abschatz, Christian Gryphius, and others. Both the Silesian schools were opposed first by the 'court poets', Canitz (1654–99), Neukirch (1655–1729) Günther (1695–1723), and others; and, secondly, by the Hamburg school, best represented by Brockes (1680–1747) and Wernike (died about 1720). Among the satirists and epigrammatists Laurenberg (1591-1659), Rachel (1617–69), and Logau (1604–55) particularly distinguished themselves. The most successful novelists were Bucholz, Von Zesen, Shupp, Anton Ulrich, Duke of Brunswick, Scriver, Butschky, but more especially Moscherosch (1601–69), the author of the Wunderliche und wahrhafte Geschichte Philanders von Sittewald; and Grimmelshausen (1625–76), whose Simplicissimus is the most entertaining book of the century. In both the last-mentioned works are to be found interesting and vivid pictures of German life and manners during the Thirty Years' war. Among the scientific and philosophic writers of the period we may mention Kepler (1571–1631), the astronomer (who wrote in Latin); Puffendorf (1632–94), the publicist; Spener (1635–1705), the founder of the German pietists; and Reimarus (1694–1765). In philosophy and learning Latin had been hitherto the general medium of literature, and Jakob Böhme (1575–1624), the great mystic, stood almost alone in using the vernacular in communicating philosophical instruction. In the latter part of the century, however, appeared Christian Thomasius (1655–1728), an able jurist, pietistic philosopher, and writer, who established the first German learned periodical (Leip-

zig, 1688–90), and who first substituted his mother-tongue for the barbarous Latin of the schools in his philosophical lectures at Leipzig and Halle. Leibnitz (1646–1716) was the first to lay a scientific basis for the study of philosophy, but his works were composed chiefly in French and Latin. Wolff (1679–1754), his disciple, shaped the views of his master into a comprehensive system, and published his works in the German language.

Under the impulse of the new philosophical ideas Germany became, in the eighteenth century, excited on the subject of reform in literature, as it had been in the sixteenth on that of theology. The century opened with the foundation of the Berlin Academy by Leibnitz (1700). Gottsched (1700–66) laboured in the same direction at Leipzig as Thomasius, exerting himself to make the German language the only medium of higher instruction, and publishing in it manuals of philosophy and science. His correct and formal taste led him to advocate the classical rules of composition of Racine and Corneille, and in religious and philosophical matters he in some measure sympathized with Voltaire. These leanings brought him into violent opposition with Bodmer (1698–1793) and Breitinger (1701–76), who admired the English poets as much as Gottsched did the French, and who were strictly orthodox in matters of religion. They carried on a paper war in their respective journals, until at length many who had rallied round Gottsched became disgusted with his pedantry and conceit, and separating themselves from him, established a periodical afterwards well-known in German literature (the Bremer Beiträge), in which they opposed their former idol. At the same time they formed a poetical union, to which Hagedorn was friendly, although he never became a member, but which was eventually joined by Klopstock. Among the contributors to this journal were Rabener (1712–91), a popular satirist with a correct and easy style; Zachariä (1726–77), a serio-comic epic poet; Gellert (1715–69), the author of numerous popular hymns, fables, and a few dramas now forgotten; Kastner (1719–1800), a witty epigrammatist and talented mathematician; Giseke, Cramer, Fuchs, Ebert, and many others of more or less note. The journal was printed at Bremen, but the poets resided for some time at Leipzig, whence they adopted the name of the *Second School*, while the followers of Bodmer styled themselves the *Swiss School*. Related to the latter was the school of Halle, to which belonged Lange, Pyra, Uz, Götz, &c. The most distinguished poets of this school were Kleist (1715–59), who took Thomson, the author of the Seasons, as a model, and Ramler (1725–98), the author of some fine odes; Gleim (1719–1803), a celebrated fabulist, at first a follower of Bodmer, gathered a nucleus of writers about him, and for about forty years exercised considerable influence on German literature; but his fame was diminished by the criticism of Herder. Gessner of Zürich (1730–87) gained in his time a high reputation as a writer of idyls; but Herder thinks he has been much overrated. The poets of most influence and importance of the period, however, are Hagedorn (1708–54), whose fables and lyrics have rendered him immortal among his countrymen; Albert von Haller (1708–77), the eminent physiologist, who was remarkable as a writer of descriptive poetry; and greatest of all, Friedrich Gottlieb Klopstock (1724–1803), the author of the Messias, the mystic and devout faith of which deeply impressed the world, while as a work of art it was thought to rival the epics of Milton and Dante. Strikingly opposed in style and spirit to this poem is the graceful Græco-Parisian epic, Oberon, by Christoph Martin Wieland (1733–1813). But it was reserved for Gotthold Ephraim Lessing (1729–81) to give a new direction to German literature. He did for it what Luther had done for the language. He established a new school of criticism and dealt the fatal blow at French influence when Frederick the Great was courting the Gallic muse. Lessing's tragedy Emilia Galotti, his comedy of Minna von Barnhelm, and his philosophic drama Nathan der Weise, are models of dramatic composition. He exerted a powerful influence on the drama by unfolding for the first time all the beauty, vigour, and originality of Shakspeare before the German mind, and by the profound and philosophical criticisms in his Dramaturgie. He condemns all foreign models except the ancient classics and Shakspeare, and desires literature to reflect its own stirring energies in the drama as being the most perfect form, and not in the continental mediæval epic, which the spirit of the age shrinks from. Among the many literary labours with which his name is associated, the most celebrated was a periodical, Literaturbriefe, which he founded in 1759 in Berlin in conjunction with Nicolai, the publisher and author. The principal contributor after himself was his friend Moses Mendelssohn (1729–86), one of the noblest characters in the history of German literature. Both Klopstock and Wieland were criticized in that periodical, and it was the first to discover the merit of the unfortunate Winckelmann, the classic archæologist, and the philosophical genius of Kant, although at that time he had written but a few short treatises. Shortly after the commencement of this publication a new influence was brought to bear upon the literary world by Herder (1744–1803). His mind was a complete storehouse of universal knowledge; he had studied closely the poets of all nations, become intimately acquainted with the Hebrew, Greek, and Latin writers, and above all possessed a cosmopolitan humanitarian spirit, which, together with his poetical genius, manifested itself most suggestively in the crowning work of his life, the Ideen zur Philosophie der Geschichte der Menschheit. He contributed in no small degree to the study of oriental poetry, and was the first to direct attention to the beauty of the early popular songs of all nations, and particularly of his own. The earnestness and dignity of his character exercised a powerful influence upon the great poets of his time, and he succeeded in imbuing other minds with his poetical conceptions, both by his personal intercourse with them, and by his varied contributions to literature. The writings of Winckelmann (1717–68), in which are given the results of his studies of the remains of ancient art, modified all the old conventional theories of the beautiful, and by his exertions, combined with those of Lessing, whose Laokoon was elicited by Winckelmann's suggestions, the spirit of art and poetry was brought back to the genuine and simple taste of the Greeks. The students of Göttingen University (then the most brilliant in Germany) became, through the teaching of Heyne, the accomplished critic and commentator, deeply impressed with the new ideas, and under the influence of the reforms which were then initiated in all departments of thought and life, founded in 1770 the Musenalmanach, a literary journal, and not long afterwards a poetical union known as the *Göttinger Dichterbund* or *Hainbund*. Among the members of the union were Gottfried Aug. Bürger (1748–94), author of Lenore and other wild and picturesque ballads and songs; Voss (1751–1826), the translator of Homer, and author of one of the finest German idyls, Luise; together with the two brothers Stolberg, Boie, Hölty, Claudius, Hahn, Cramer, Johann Martin Miller, &c. The reformatory period was followed by a time of transition and excitement known in Germany as the *Sturm-und*

Drang Periode, which found its fullest expression in the Leiden des jungen Werther (Sorrows of Werther), one of the earliest works of Germany's greatest literary genius Johann Wolfgang von Goethe (1749–1832), and with more exaggeration and less poetic inspiration in the sensational tragedies and novels of Klinger (1753–1831), from one of whose dramas the period was so designated; and in the works of Schubart, Heinse, Lenz, and Müller. The literary excitement was driven to the highest pitch of excitement by the Räuber (Robbers) of Friedrich von Schiller (1759–1805), afterwards the friend and worthy coadjutor of Goethe. By the joint exertions of these two great men German literature was brought to that classical perfection which, from a purely local, has since given it a universal influence. Goethe possessed the plastic imagination of a Greek, the glowing fancy of an oriental, and the melodic ear of an Italian, together with genuine German feelings. Versed in almost every human science, master in every department of literature, he became the acknowledged sovereign of intellectual Germany; while Schiller, by his enthusiastic and eloquent pleading for political and intellectual freedom, his wide human sympathy, and by the simple yet classical elegance of his style, became the favourite of the people. The contemporaries and immediate successors of Lessing, Herder, and Mendelssohn in the walks of science and philosophy and history are A. G. Baumgarten (1714–62), the founder of the science of Æsthetics, whose works are written in Latin; Meir, the popular interpreter of his ideas; Lavater (1741–1801), the physiognomist; Lichtenberg (1752–99), his keen and polished antagonist; the historians Mosheim (1694–1755), Dohm, Möser, Spittler, Johannes Müller; Adelung the philologist; Basedow and Pestalozzi the educationalists; Ernesti, Spalding, Rosenmüller and Michaelis, theologians; Eichhorn in theology and universal and literary history; and the scientific writers Blumenbach, Euler, Vega, Herschel, and others. Closely related to the theological and psychological writers stand Nicolai, whose novel Sebaldus Nothanker satirized unsparingly the dead, hard dogmatism, or violent fanaticism of the narrow-minded and illiberal teachers of theology; Engel, the author of Lorenz Stark; Jacobi, the author of several metaphysical novels; Jung Stilling, the tailor, in whose autobiography Goethe took such a deep interest; and Jean Paul Friedrich Richter (1763–1825), who, possessing a deep fund of humour and pathos, and a wide experience of life, wanted in a painful degree the power of arranging his ideas, and often of lucidly expressing them in consequence. In the field of pure metaphysics Immanuel Kant was succeeded by Fichte (1762–1814), Hegel (1770–1831), and Schelling (1775–1854).

Partly produced by the influences of the *Sturm-und-Drang* period, and partly trained in the laws of art laid down and worked out by Goethe and Schiller, the so-called romantic school gradually succeeded in gaining public attention about this epoch and holding favour for a considerable time. The head of this school, Von Hardenberg, better known under the pseudonym of *Novalis* (1772–1801), was a poet and prose writer remarkable for scattered thoughts of wisdom and deep poetic insight, combined with morbid sentiment, and buried under a crude style. Diametrically opposed to him, although considered as belonging to the same school, is August Wilhelm von Schlegel (1767–1845), the author of the antique tragedy Ion, and of many elegies and romances, but chiefly remarkable for his admirable metrical translation of Shakspeare, his critical and æsthetic writings on the drama, and his labours connected with the Indian and Sanskrit literature and language. The speciality of his equally eminent brother Friedrich von Schlegel (1772–1829) was the history of ancient and modern literature, and the philosophy of history. The most original representative of the school was Ludwig Tieck (1773–1853), whose poetical dramatization and collection of fairy and popular tales reflect the romance of mediæval poetry with beauty and vigour, but with a mystic feeling akin to superstition. La Motte Fouqué is unrivalled in the power of giving Ariel-like delineations of the mysteries of fairy lore, instinct with grace, loveliness, and spirituality; as, for instance, in his Undine. Chamisso (1781–1838), a sweet lyrical poet, and the author of Peter Schlemihl; Tiedge (1752–1841), the author of Urania; and Werner, a mystic religious poet, all belong to this school; and with the exception of the spirited poet Seume (1763–1810), and the Aristophanic Platen (1796–1835), most of the writers had a morbid passion for romantic and sentimental views of life. This epoch comprises the lyric poets Stägemann, Kosegarten, Baggesen, Matthisson, Salis, Mahlmann, and Eichendorf, many of whom belong to the romantic school. Among the novelists and tale writers are Achim von Arnim (1784–1831), and Clemens Brentano (1777–1842), the compilers of a collection of popular songs (Des Knaben Wunderhorn); Ernest Hoffman (1776–1822), the author of the fantastic and wild tales Elixire des Teufels, Kater Murr, &c., which carry to a climax the supernaturalistic element of the romantic school; Musæus, the author of a collection of Volks-Marchen, or popular fairy tales; Thümmel, Knigge, and Karl Immermann (1795–1840), the author of the famous novel Münchhausen. Several authoresses contrived to gain considerable reputation about this period, the most notable of whom are Bettina von Arnim, Goethe's celebrated correspondent, and in the early part of her career associated with the romantic school; the Countess Ida von Hahn-Hahn, Auguste von Paalzow, Amalie Schoppe, Fanny Lewald, Johanna Schopenhauer, Frederike Brun, and others.

The war of liberation against Napoleon I. introduced a strong manly enthusiasm for a time into the hitherto gloomy and melancholy productions of the romanticists. The spirit of national liberty was roused and sustained by the stirring patriotic lays of Ernst Moritz Arndt (1769–1860); Theodor Körner (1791–1813), the gallant soldier poet, whose last song (the Schwertgesang) had just left his hand when he had to grasp the sword for the heroic encounter with the hated French, in which he died, as he wished, a hero's death; Friedrich Rückert (1789–1866), the author of the Geharnischte Sonnette, also celebrated for his versions of oriental poetry and imitations of troubadour songs; Ludwig Uhland (1787–1862), whose ballads and metrical romances have brought him a world-wide fame, and who was the recognized head of the modern Suabian school. This poetical union had its head-quarters in Stuttgart, the seat of the great publishing firm of the Cottas, and the residence of the eminent critic Wolfgang Menzel. It counts among its members Gustav Schwab (1792–1850), Justinus Kerner (1786–1861), Gustav Pfizer, Eduard Mörike, Karl Mayer, &c. The efforts of Lessing, Herder, Klopstock, and others to revive the popularity of early German poetry, and to destroy the then prevailing taste for French and Italian literary forms, have contributed to give a powerful impulse to the researches into the ancient German literature, which was to some extent fostered by Jahn's spirited work on Deutches Volksthum. The brothers Grimm —Jakob (1785–1863), Wilhelm (1786–1859), were the more immediate founders of this new branch of philological and poetic investigation. Von der Hagen, Lachmann, and Simrock, by their various editions of

the Nibelungenlied, have done much to promote a love for the study of the old German dialects and the literature connected with them; and Moritz Haupt, Oskar Schade, Franz Pfeifer, Hoffmann von Fallersleben, and Karl Bartsch, have more recently laboured in the same direction. Among the many eminent names in general philology are those of Bopp, Pott, Schleicher, Steinthal, and Karl Brugmann.

The political excitement produced in Germany by the French July revolution (1830) gave a new direction to literary activity. A school of writers styled *Junges Deutschland*, arose, in whose poems, dramas, and novels the social and political ideas of the time were strongly reflected. The forerunners of this party were Ludwig Börne (1786–1837), by his pungent political satires, and Heinrich Heine (1799–1856), a writer gifted with great penetration and political and philosophical insight. No writer except Goethe has been better able to introduce into lyrical poetry that language which seems to be the echo of the longing thoughts of the human heart, but he wilfully destroyed his own influence by his frivolity, sensualism, and irreligion. The most important member of the young German school was Karl Gutzkow (1811–78), author of several celebrated novels (Der Ritter vom Geist, Der Zauberer von Rom, &c.), a popular dramatist, and one of the most active journalists of Germany. Among other notable representatives of the school are Mundt (1807–61), Kühne, Laube, and Wienbarg. Another eminent writer of this period is Baron Sternberg, whose novels reflect the social and political condition of his country; and closely related to him in tendency and aim stands Prince Pückler-Muskau. The taste for poems and novels of a social and political character has continued down to our day, and has been gratified by Hoffmann von Fallersleben (1798–1874), Georg Herwegh, Dingelstedt, Kinkel, Prutz, Freiligrath, &c. Among the other poets of the most recent period whose names are best known we may mention Emmanuel Geibel (perhaps the most popular German poet of the day), Grabbe, Gottschall, Paul Heyse, Wolfgang Müller, Bodenstedt, Anastasius Grün (Count Auersperg), Lenau, Otto Roquette, Karl Beck, Meissner, Redwitz, Kinkel, Zedlitz, Hamerling, Bishop Pyrker, &c. The most successful novelists of this or the immediately preceding generation are Karoline Pichler (1769–1843), Zschokke (1771–1848), Karl Spindler, W. Häring (1797–1871), the German Sir Walter Scott (famous under his pseudonym Wilibald Alexis); Berthold Auerbach (1812–1882), the author of the Village Tales of the Black Forest; Gustav Freytag, best known as the author of Soll und Haben (known to English readers as Debit and Credit); and the Verlorene Handschrift; Gerstäcker, Wil. Hackländer, L. Schücking, Heyse, G. zu Putlitz, Mügge, O. Müller, Klaus Groth, &c. Dramatic literature has fallen from the high estate which it reached through Lessing, Goethe, and Schiller. Their more immediate successors were Gerstenberg (1737–1823), Cronegk, Leswitz, C. F. Weisse; Iffland (1759–1814), Werner (1768–1823), the founder of the Schicksalstragödie (Fate Tragedy), by his piece called the Vierundzwanzigster Februar; Kotzebue (1761–1819), one of the most prolific dramatic writers of all nations, having written in his short span of life about 200 pieces in all, some of which have been put upon the English stage; Karl Immerman (1796–1840); Raupach (1784–1852); Franz Grillparzer, Bauernfeld, Gutzkow, Benedix, Charlotte Birchpfeifer, Münch-Bellinghausen (better known as Fried. Halm), Laube, Hebbel, Gottschall, G. Freytag. The tendency of the most eminent German minds is showing itself more and more in their increasing partiality for the spheres of science and learning, rather than the poetic and dramatic department of literature. Alexander von Humboldt (1769–1859) gave a great impulse to almost all branches of knowledge by his Cosmos, his Travels, and his Views of Nature, and by the general suggestiveness of his labours. While he marks a new epoch in the pursuit of the natural sciences, another great movement was initiated in historical researches by Niebuhr (1776–1831), the historian of Rome. Heeren (1760–1842) investigated history in connection with political and commercial relations. Other noted historians are Ranke, the historian of the Popes; Dahlmann, Rotteck, Schlosser, Gervinus, the author of a History of German literature, and the historian of the nineteenth century; Lappenberg, author of a History of England, completed by Pauli, which is considered a valuable work by English authorities themselves, Mommsen (History of Rome, &c.), Sybel (French Revolution), &c. Among the historians of literature we may mention Von Hammer-Purgstall, an earnest student of oriental literature, and author of histories of Turkish and Arabian literature; Julian Schmidt, who has written a history of German literature since the death of Lessing; and Heinrich Kurz and W. Wackernagel, historians of German literature, the work of the latter unfortunately uncompleted at his death in 1869. Another worker in the field of historical literature was King John of Saxony (1801–73), who, under the name of Philalethes, published a metrical translation of Dante, enriched with many valuable notes and commentaries; and Eckermann, the compiler of the Conversations of Goethe; while biography has been well represented by Varnhagen von Ense (1785–1858), Pertz, David F. Strauss, and others. The literature of travels—especially travels undertaken with scientific objects in view—was greatly stimulated by A. von Humboldt, who inaugurated a new era by his famous journeys in the equatorial regions of America. Other names of note in this department of literature are Ida Pfeifer (1798–1858), the brothers Schomburgk, Lepsius, Brugsch, the brothers Schlagintweit, Barth, Vogel, Rohlfs, Schweinfurth, &c. We conclude with a list of eminent men in the principal departments of learning in Germany. In the natural sciences: Oken, Burmeister, Carus, Bern. Cotta, Ule, Endlicher, Bischoff, Kopp, Poggendorf, Wackenroder, L. von Buch, Naumann, Liebig, Erdmann, Helmholtz, Virchow, Schleiden, Grisebach, Vogt, Bessel, Brehm, Haeckel, Bastian, Sachs, &c. In medicine: Johannes Müller, Burdach, Ehrenberg, Hecker, Blasius, &c. In astronomy and mathematics: Bessel, Encke, Struve, Gauss, Mädler, &c. In geography, ethnology, and statistics: Karl Ritter, Wappäus, Petermann, Scherzer, Berghaus, Klöden, Stein, Streit, &c. In theology and biblical criticism: Baur, Bleek, Ewald, Strauss, Keim, Ritschl, Pfleiderer, Harnack, and others. Among historians of art there are Kugler, Burckhardt, Lübke, and others. In philosophy: Schopenhauer, Feuerbach, Rosenkranz, Kuno Fischer, von Hartmann, Lotze, &c. See the Histories of German Literature by Kurz, Wackernagel, Vilmar, Julian Schmidt, Koberstein, Gervinus (German poetry), &c.; and in English, Metcalfe's, Menzel's, Scherer's, Gostwick and Harrison's, &c.

GERMAN ART. — I. *Architecture.* — During the whole of the period which elapsed between the withdrawal of the Romans and the reign of Charlemagne Germany seems to have been in such a state of anarchy that no great buildings were or could be undertaken. At all events no trace of any edifice of this age remains, nor even a tolerably distinct tradition of any one being founded by the unsettled

barbarian tribes who occupied that country when deprived of the protection of the Roman Empire. With the accession of Charlemagne commences a brighter era. He restored the authority of the laws, and encouraged the arts of peace, and founded many noble structures, many of which, in whole or in part, remain to the present day. This gleam of tranquil brightness appears to have been more owing to the individual greatness of the sovereign than to the ripeness of the people for more civilized institutions; for on his death they relapsed into confusion and barbarity. From this state the land partially recovered under the first three Ottos, in whose reigns church-building seems to have been renewed with some energy. Up till the end of the twelfth century the prevalent style of architecture was the Byzantine, the low state of German civilization compelling the employment of Greek or Italian artists. The cathedrals of Spires, Worms, Mainz, Bamberg, Basel, Würzburg, Limburg, Erfurt, Treves, Nürnberg, all conform in their primitive parts to the Byzantine style. But about the twelfth century the Gothic began to make its appearance; from that time the ogival and semicircular arch were both in equal favour. Towards the close of the following century the Gothic, as a purely German style, replaced those brought from the south. The churches of that period are all of the pure Gothic character. Such were the cathedrals of Meissen and Magdeburg, buildings of a severe and simple taste. This style was succeeded by a second, not less grand, but more ornate and elegant. The cathedral of Friburg opened this new era; its front spire, erected in 1272, is the first and finest in the open style, and altogether the church is the most perfect monument of Gothic art remaining. The cathedrals of Cologne and Strasburg were both commenced about the same epoch. The latter edifice has a peculiar interest for the student of art, as in it is plainly marked the progress of architecture from the heavy Lombardo-Byzantine style to the degenerated after-Gothic style. In spite of these traces of bad taste the Strasburg cathedral was considered in the middle ages, and at the era of the Renaissance, the finest structure in Germany. The fourth chef d'œuvre of German art is the church of St. Stephen at Vienna, commenced about the middle of the twelfth century. It is regarded as the last expression of the pure Gothic style. Among the other noble churches of this epoch may be mentioned those of St. Laurence and of St. Sebald, the latter remarkable for its Gothic general plan with Arabic ornamentation; that of St. Mary in the same town, by Georg and Fritz Ruprecht; St. Catharine's of Oppenheim, the cathedral of Goslar, St. Mary's of Königsberg, &c. The fourteenth and fifteenth centuries witnessed the erection of the magnificent cathedral of Ulm, commenced under the direction of Matthias von Ensingen, and continued by Boblinger and Engelberger; the cathedral of Augsburg; the beautiful church of Landshut; that of Esslingen, renowned for its elegance; that of Dunkelsbühl, by Nicolas Eseller; St. Giles' of Prague, constructed by Peter von Arler and Matthias von Arras; St. Mary's of Würzburg, the cathedrals of Innspruck, Salzburg, Bremen, Dantzig, Constance, Berne, Zürich, Lausanne, &c. Among the most remarkable monasteries must be classed those of St. Gall, Fulda, Lindau, Lorsch, Treves, Hildesheim, St. Blaise in the Black Forest, Einsiedeln in Switzerland, &c. Civil architecture took its rise shortly after ecclesiastical. After the towns had succeeded in securing their freedom and become prosperous, they first erected a church to their patron saint, and then constructed handsome council halls, bridges, quays, custom-houses, immense warehouses, hospitals, &c. All these edifices are characterized by their simple and elegant forms, appropriate to the uses for which they were intended. The public buildings of Dresden, Ulm, Goslar, Bremen, Nürnberg, Cologne, and Mainz, are among the most celebrated specimens. About the beginning of the fifteenth century the pure Gothic art commenced to decline. The sanguinary religious wars of Bohemia destroyed the unity of belief, and diminished the spirit of enthusiasm which had led to lavish expenditure in the interest of the church. From that time new ecclesiastical structures were not only not undertaken, but those partially built were for long left unfinished. The war of the Hussites, and the Reformation inaugurated by Luther, were fatal to the magnificent old Gothic style. About this time the revival of art in Italy was making itself felt, and Germany, in consequence of her relations with that country, adopted, in some measure, the ideas of the Italian architectural school; and although in the churches several of the ancient forms were adhered to, the new style soon gained complete possession of the field. As instances of a compromise between the two styles we may cite the Jesuits' church at Munich; the town-hall and the tower at Perlach; the churches of St. Charles and St. Peter at Vienna (the last-mentioned on the plan of St. Peter's at Rome). This style, characterized by its intricacy of outline and prodigality in ornamentation, prevailed up till the end of the eighteenth century, when three eminent men, Raphael Mengs, Winckelmann, and Lessing, opened their campaign in favour of purer and more dignified forms. Weinbrenner an architect of Baden, animated by their spirit, lent his powerful aid, and became the head of a school which, in spite of its imitation of classical antiquity, has given Germany a host of learned and enlightened architects: Hansen, who found a sphere of activity in Hamburg and Denmark; Fischer, who planned the Munich theatre, and others. After them the school (called the archeological and æsthetical) was represented by Klenze. This architect, in the many edifices erected from his designs at Munich, has shown a wide and profound knowledge of the various styles of architecture. The Glyptothek is Ionian in style; the royal palace, Florentine; the church of All-Saints is Byzantine; several details of the Pinakothek are borrowed from the Vatican; and in the Valhalla of Ratisbon he has imitated the rude Cyclopean walls. His royal patron, Louis of Bavaria, who merits the title of regenerator of the arts, employed many other famous architects, such as Gärtner, Ohlmüller, Liebland, Pertsch, and Probst, and had the honour of leaving to his country a city of palaces. The King of Prussia followed his example to some extent, and his architect Schinkel planned many of the best edifices in Berlin and the provinces. Among his principal works in the capital are the royal palace, the museum, the theatre, the conservatory, &c. Knoblauch is a more recent architect, who erected some fine buildings in Berlin; while Semper is equally distinguished for edifices erected in Zürich, Dresden, and Vienna.

II. *Painting.*—Although painting in Germany can be traced back to the age of Charlemagne, little is known of the productions of its artists, the missal illuminators alone excepted. The dome of the cathedral erected by that monarch at Aix-la-Chapelle he caused to be covered with mosaics representing Christ enthroned, with the elders worshipping; the walls of his palaces glittered with representations of his own victories; his oratories with Scriptural subjects or legends of the saints—all the work of foreign artists of the Byzantine school. Of these paintings and mosaics no vestiges remain. The Byzantine influence was predominant up till about the middle

of the twelfth century, when visible signs of new life in art began to manifest themselves. Ecclesiastical art took a wider scope; more artistic individuality was displayed; the drawing of the figure was improved, and expression was studied. The miniature painters especially made a marked advance, and many excellent specimens of their work remain. In the Parzival of Wolfram von Eschenbach, who lived early in the thirteenth century, the painters of Cologne and Maestricht are especially mentioned; and the series of compartments on the ceiling of the former monastery of Brauweiler near Cologne, of about 1200, representing the Triumph of Faith; and the figures of the apostles, one of which bears the date 1224, in the church of St. Ursula in Cologne, are probably the oldest German pictures extant. But a more important work is the series of paintings on the choir and transept of Brunswick Cathedral, which appear to be of about the middle of the thirteenth century. A school of very skilful artists seems to have existed about this time in Bohemia, but towards the close of the fourteenth century the painters of Cologne recovered the lead under Meister Wilhelm, who is described by a contemporary writer as the best master of his day, who painted all sorts of men as if they were alive. The pictures in Cologne attributed to this master and his scholar Meister Stephan, notwithstanding a Gothic hardness peculiar to all mediæval German art, are remarkable for richness of colouring, careful finish, and deep religious sentiment. Contemporary schools flourished in Nürnberg and Westphalia. The sixteenth century witnessed the culmination of German art in the person of Albrecht Dürer, the scholar of Michael Wohlgemuth of Nürnberg, and almost equally distinguished as painter, sculptor, and engraver, though now chiefly known in the last capacity. In feeling for ideal beauty Dürer is far inferior to his great Italian contemporaries; in colour he is inferior to both the Italian and Flemish artists; but in originality of conception, fertility of imagination, dramatic power, force of expression, and correctness of drawing, he ranks with the highest. He found a numerous host of imitators, many of whose works in the various European collections are attributed to the great master. Among the principal of his disciples are Hans Wagner, Schäufflein, Beham, and Albrecht Altdörfer, the best of all his pupils. The contemporary school of Saxony was headed at this time by Lucas Cranach, who enjoyed almost as great a reputation as Dürer himself. His pictures are well coloured but fanciful, and the features of his females most singular. Other painters of the period are Matthias Grunewald; Hans Burgkmair, chief of the Augsburg school; and more particularly Hans Holbein the younger (1498–1554), the type of old German realism, and, like Dürer, also great as an engraver, as shown in his Dance of Death. The German painters of the seventeenth century were nearly all imitators of the Dutch, Flemish, or Italian masters, and many of them resided permanently in the Netherlands or Italy. Joachim von Sandrart (1606–88), Heinrich Schönfelds (1609–75), Heinrich Roos, and his son Philip Roos (1655–1705), better known as Rosa di Tivoli, were among the best German artists of this period. In the eighteenth century painting in Germany, as elsewhere, was coldly academic and conventional, devoid of all originality and feeling. Rode (1725–97), J. H. Tischbein (1722–89), and Raphael Mengs (1728–74) are among the few painters of the century whose names are still remembered. In the early part of the nineteenth century a remarkable revival was commenced by a number of young German painters resident in Rome, who protested against the effete academic generalization under which art languished. The result was the formation of a mystical school, which, under the guidance of Overbeck, Veit, Schadow, and others, has attempted to revive the sentimental ascetic art of the fourteenth century; and of another more purely Teutonic school, under Cornelius, Kaulbach, Hess, and Schnorr, who have idealized history with considerable success. In opposition to the essentially Catholic school of Overbeck has sprung up in Düsseldorf a Protestant one under Lessing, Bendemann, Knauss, Hübner, Röder, &c., which, though inferior to its rival in grandeur of conception, has given to Germany her best contemporary landscape and genre painters.

III. *Sculpture.*—The origin of this art in Germany is to be sought in the labours of the monks; the ornamentation of their sacred vases, the carvings on the ivory covers of their missals, shrines, and the fronts of their altars, were the first essays in the art. The working of the Hartz mines, under the auspices of the first three emperors of the name of Otho, brought a considerable quantity of the precious metals into Germany, and for works in gold and silver the Germans acquired a European reputation. It is not, however, until we come to the fourteenth century that we meet with the names of any sculptor of importance. Johann of Cologne, Berthold of Eisenach, and Sabine of Steinbach (daughter of the architect of Strasburg Cathedral), have perpetuated their names; but those of the artists who sculptured the colossal statue of Rudolph IV. at Neustadt, that of William Tell at Zurich, the sculptures of the town-hall at Nürnberg, have been forgotten. In the fifteenth century the school of Nurnberg became the most renowned in Germany, its members carrying the art to higher perfection than had ever been attained in the country. The most important names of this era are Johann Decker, Adam Kraff, Veit Stoss, Seb. Lindenast, but above all Peter Vischer, who even yet has found no rival among his fellow-countrymen. His principal work is the tomb of St. Sebaldus in the church of the same name in Nürnberg. From his time up till the close of the last century Germany produced scarcely a single artist worthy of the name. The only sculptor who acquired any considerable reputation was Matthias Collin, who adorned with superb sculpture the tomb of the Archduke Maximilian of Austria at Salzburg. The efforts of Mengs, Lessing, and Winckelmann, however, arrested the downward progress of the art, and the successes of the great masters Canova and Thorwaldsen encouraged the German sculptors to a patient study of ancient classical art. A revival soon took place, inaugurated by Dannecker, Ohnmacht, and by Schadow, Rauch, and Tieck, the heads of the modern Berlin school. Under the generous fostering care of King Louis of Bavaria, his capital was enriched by the productions of the great artists who founded the Munich school—Eberhard, Wagner, and more particularly Schwanthaler, who has almost arrived at the perfection of the ancient Greek masters. In conclusion we may mention the names of Kiss, one of Tieck's most promising pupils; of his fellow-disciple Drake; and of the brothers Eberhard, especially of Conrad Eberhard, who has applied the principles of the romantic school to German sculpture.

IV. *Music.*—Of the music sung by the ancient Germans to their songs of war and festivity; of the old church-music introduced into the country by the teachers of Christianity, and which the chroniclers say was powerfully instrumental in converting the Saxons and Slaves; and even of the melodies of the courtly Minnesänger and the earlier Meistersänger, not a single trace exists. The first authentic monuments we possess of the art is found in a collection of hymns by Johann Hus or Huss, the reformer,

In the fifteenth century a knowledge of the art was pretty common in Germany, and the compositions of Heinrich Isaac, Adam de Fulda, Stephan Mahn, and others, will contrast favourably with those of the musicians of any nation whatever. The German people before the period of the Reformation had taken considerable interest in sacred music, and had on various occasions manifested a wide-spread desire to take part in the musical service of the church; this the ecclesiastics seemed determined to repress, by the employment of trained choirs, instrumentalists, and the introduction of musical compositions of a very elaborate character. Luther, the leader of the Reformation, however, took a totally different course. A musician of no mean note himself, he composed several majestic chorals, and succeeded in rendering the sacred service of song at once popular and magnificent. Even at this period music of a less severe cast was not neglected: witness the works of Jacob Gallus, Schütz, Schein, Vulpius, and Prätorius, &c. In 1627 the opera of Daphne, the libretto adapted by Opitz from the Italian, the music composed by Schütz of Dresden, was produced in that city, and may be considered the first attempt to introduce the opera pure and simple on the German stage. It was not, however, until the beginning of the eighteenth century that the Germans produced operatic music possessing considerable merit and impressed with national character. Keyser of Hamburg, and Fux of Vienna, were not mere imitators of the Italian musicians, as many of their predecessors had been. Later on in the century we come upon the names of J. S. Bach and Handel, the great oratorio composers; Hasse, Graun, Telemann, in the opera and cantata; Em. Bach, famous for his instrumental music; Gluck, the founder of the modern opera; Haydn, in oratorio and instrumental music; Mozart, the master of all styles; and the giant Beethoven, who has, in the opinion of many, carried the musical art to its utmost limits. In the nineteenth century the art has found worthy exponents in Franz Schubert, Spohr, Weber, Marschner, F. Schneider, Mendelssohn, Meyerbeer, Schumann, and others; together with Richard Wagner, whose theories have for two or three decades divided the musical world into two hostile camps. In nearly all kinds of instrumental music the Germans may be said to have surpassed all nations; the music of wind-instruments seems to belong exclusively to them. Their organists are unrivalled, and their orchestras are well regulated. In musical literature none can approach them: witness the works of Fux, Matheson, Marpurg, Kirnberger, E. Bach, Albrechtsberger, Forkel, Koch, and a host of others. At the present time it is not surprising that the success of the Germans should be so extraordinary, seeing that there is no school for the education of youth in the country at which music is not thoroughly taught and cultivated, even down to those in which children receive gratuitous instruction.

GERMINATION, the first act of vitality in plants. Its immediate causes are the presence of moisture and atmospheric air, and a certain elevation of temperature. Moisture softens the integuments of the seed and relaxes the tissue of the embryo; atmospheric air supplies oxygen and nitrogen; and a temperature which must be at least equal to 32°, by exciting the vitality of the embryo, enables it to take advantage of the agents with which it is in contact. The quantity of moisture necessary to germination varies with the nature of the plant. Hence in water-plants total immersion seems necessary, whereas in land-plants moisture is most safely applied in the form of vapour. Free access to the atmosphere is absolutely essential, and hence seeds buried in stiff clay, or at considerable depths below the surface, do not germinate. The temperature required for the germination of all cultivable plants must be somewhere between 32° and 100°, and in general rather above than below the temperature to which the plant is accustomed during its growth. The most favourable germinating temperature for ordinary agricultural crops is 40° to 50°; for more tender kinds, as maize, 60° to 70°; and for tropical annuals, like tobacco, 80°. During the process of germination various changes take place in the chemical constituents of the seed, and are usually accompanied with increase of temperature, as is observable in the case of malting. Along with these changes others of equal importance are produced in the embryo. First a root is produced, which strikes perpendicularly downwards, and fixing itself in the soil, begins to absorb food; a growth upwards then commences, and ends in the protrusion of a stem and leaves. Germination once commenced and arrested can never be restored, and hence the numerous failures to germinate seeds which have undergone long voyages. In hot latitudes the elevation of temperature and consequent production of moisture in the packages produce an incipient germination which suffices to destroy all future vitality. The cause of this unfortunate result suggests its remedy. Seeds intended to pass the tropics, instead of being stowed away in air-tight barrels or boxes in the hold of the vessel, should be kept in bags or sacks in an airy cabin. A mysterious effect has sometimes been assigned to the steeping of seeds, and it has even been gravely proposed to employ peculiar kinds of steepings as a substitute for manures. In the case of bony or very hard seeds steeping may be useful by swelling the seed so as to secure the bursting of the tough integuments which inclose the embryo; but the practice of seed-steeping, to influence the future crop, is delusive.

GERNING, JOHANN CHRISTIAN, an entomologist, born at Frankfort-on-the-Main in 1745; died in the same place in 1802. He prepared most of the text of the great work Papillons de l'Europe (Paris, 1780–92). He left one of the largest collections of insects ever made by a single individual. It contains more than 30,000 specimens, about 5500 species, and 500 varieties, and is still in Frankfort.

GERONA, a maritime province of Spain, included in the old province of Catalonia; bounded on the north by France; east and south-east by the Mediterranean; south and south-west by Barcelona; and west by Lerida; area, 2272 square miles. The surface is mountainous, branches of the Pyrenees ramifying throughout its whole extent, for the most part rugged, bare, and precipitous near their summits, but well wooded lower down; and forming numerous fertile valleys and verdant slopes, in many places clothed with vineyards and olive plantations, and yielding also wheat, rye, barley, oats, hemp, and all kinds of fruits and vegetables. Sheep, goats, horned cattle, horses, and mules are reared, and game is abundant. The mineral wealth consists chiefly in a few mines of iron, lead, and coal. The province is watered by the rivers Ter, Fluvia, Marnol, Muga, and several smaller streams, all of which fall into the Mediterranean. The manufactures include linen, woollen, and cotton fabrics, ropes, paper, soap, leather, cork bungs, earthenware, hardware, &c., but are of limited extent. There is a trade in manufactured goods, agricultural produce, wine, oil, and cattle. The inhabitants are chiefly engaged in agriculture; and, along the coast, in ship-building, fishing, and as mariners. Capital, Gerona. Pop. (1897), 298,497.

GERONA, a strong town of Spain, in Catalonia, capital of the province of the same name, at the confluence of the Oña and the Ter, 52 miles north-east of Barcelona. It is built in the form of a triangle,

on the slope and at the foot of a steep mountain. It is surrounded with good walls, flanked with fortifications, and covered by two forts erected on the mountain. Besides these it has five fortified buildings. The streets are narrow and winding; the houses tolerably good. It has a seminary of education on a large scale. The cathedral, erected in the fifteenth century, is a majestic pile, built on an eminence, and approached by a superb flight of eighty-six steps. Connected with the cloisters is a noble old Roman tower. Gerona was taken by the French in 1809, after a protracted and brave resistance under its heroic governor Mariano Alvarez. P (1897), 16,081.

GERONTES (that is, old men), members of the *Gerousia* or council of the elders at Sparta, and in other Doric states of ancient Greece. They could not be elevated to this dignity before their sixtieth year. They obtained the office by popular election, conducted after a very primitive fashion. They could not be removed from office unless in extreme cases. They were thirty in number, including the two kings.

GEROPIGA, or JERUPIGA, the name of a liquid compound imported into this country from Portugal and used to adulterate wine. It is made up of about one-third part of brandy 25° above proof, of the unfermented juice of the grape, and of various sweetening and colouring matters. It is allowed into this country at the same duty as wine when it does not contain more than 33 per cent. of proof spirits, and it is permitted to be mixed with wine in the bonded warehouses in the same proportion relatively to its strength as brandy, so that geropiga of half the strength of brandy may be mixed with wine to an amount double of that which would be allowed in the case of brandy.

GERS, a department of France, bounded on the north by Lot-et-Garonne, north-east by Tarn-et-Garonne, east and south-east by Haute-Garonne, on the south by Hautes-Pyrénées, south-west by Basses-Pyrénées, and west by Landes; greatest length, east to west, 72 miles; greatest breadth, 55 miles; area, 2425 square miles. The surface in the south is almost wholly covered by ramifications of the Pyrenees, which in proceeding north lower rapidly, leaving between the ridges a number of longitudinal valleys, each watered by its own stream. The chief of these are the Save, Gimone, Rats and Gers, Baise and Losse, belonging to the basin of the Garonne, and the Douze and Midou, belonging to that of the Adour. About one-half of the whole surface is under the plough, though the soil is only of medium quality, and about one-seventh in vineyards. The principal crops, besides the ordinary cereals, are maize and flax; onions also are grown on a large scale. The produce of the vineyards is mostly consumed on the spot or converted into brandy, very few of the wines (the best of which are Vertus and Mazère) bearing a high name. Of domestic animals the finest breeds are mules, swine, and poultry. Neither minerals nor manufactures are important. Gers includes five arrondissements, Auch (the capital), Condom, Lectoure, Lombez, and Mirande. Pop. (1901), 236,204.

GERSON, JEAN CHARLIER, a celebrated French theologian, the son of a peasant farmer in moderate circumstances, born at the village of Gerson (from which he took his name), near Réthel, in 1363; died at Lyons in 1429. At the age of fourteen he was taken by his parents to Paris to study theology. He was entered at the College of Navarre, and applied himself to theological studies with such ardour that he soon acquired distinction, and in 1387, although then holding only the rank of bachelor, was appointed member of a deputation sent to the pope at Avignon in connection with the controversy about the immaculate conception. In 1392 he obtained the degree of doctor, and only three years later (1395) he succeeded at the age of thirty-two his master Pierre d'Ailly in the office of chancellor of the University of Paris, then the most famous university in the world. His first endeavours were directed towards improving the internal condition of the university. He tried to banish the useless disputations and refined subtleties of scholastic theology, and to bring back the study to its proper sphere; he controverted the astrologists, and opposed the mystical and pantheistic doctrines which were then finding their way into the university from their great stronghold in Brabant. He desired to have the people instructed, and published for the use of the unlearned classes small treatises in French on religious subjects. But in all these efforts he met with constant disappointments, and by his boldness in denouncing the vices of the great he only succeeded in making for himself enemies in the most powerful quarters. He had the courage to point out to Charles VI. the calamities which had been brought on France through the fault of the princes, and thus exposed himself to the anger of the Duke of Orleans. He afterwards drew on himself the anger of the Duke of Burgundy by denouncing him for the part which he had taken in the murder of the Duke of Orleans, and demanding of the king the condemnation of the apology which the duke had got written in his defence. But the great event of Gerson's life was his connection with the efforts made to bring about the cessation of the great schism which had divided the church since 1378. In that year two popes had been elected, one of whom had his seat at Avignon and the other at Rome, and successors had been appointed to both. In order to restore unity to the church Gerson proposed that both claimants for the Papal chair should be deposed, and a third elected in their room—a step which was actually taken by the council held at Pisa in 1409, of which Gerson was a member as deputy of the University of Paris. This proceeding, however, had not the desired effect. The popes deposed by the Council of Pisa refused to surrender their claims, and thus the only result was that there were now three rival popes instead of two. When the Council of Constance (1414–18), in which also Gerson took a leading part, likewise proved unable to settle the differences existing in the church, he at last gave up the struggle in despair, and not daring to return to France, where the Burgundians had then the upper hand, sought shelter for a time in Bavaria and Austria. After the murder of the Duke of Burgundy in 1419 he returned to his native country, and spent the last ten years of his life with his brother the prior of a community of Celestine monks at Lyons, living an ascetic life, and devoting himself to religious meditation and the composition of theological and other treatises. The most complete edition of the works of Gerson is that published by L. E. Du Pin at Antwerp in five vols. in 1706. The authorship of the Imitation of Christ, the work which next, after the Bible, has been most frequently published and translated, is by some ascribed to Gerson, but the claim of Thomas à Kempis is now regarded as better founded.

GERSTÄCKER, FRIEDRICH, a German traveller and novelist, born at Hamburg May 10, 1816; died at Brunswick May 31, 1872. He was destined from his boyhood for a mercantile career, but he soon abandoned this line of life, and impelled by his adventurous spirit embarked for America, where he wrought on a farm for two years (1835–37). Between 1837 and 1843 he traversed all parts of the United States, finding employment now as a stoker on board a Mississippi steamer, and at other times as a sailor, colporteur, jeweller, woodcutter, innkeeper, and trapper in the prairies of the West. On his return to

Germany a publisher offered to publish his journal, and induced him to adopt the profession of literature. He published in succession Streif-und Jagdzüge durch die Vereinigten Staaten Nordamerikas (Dresden, 1844), Die Flusspiraten des Mississippi (1848), Mississippibilder (1847), &c. Between 1849 and 1852 Gerstäcker was engaged on behalf of the German government in a voyage round the world in order to collect information which might be of benefit to German emigrants. An account of this tour was published by him after his return, first in a periodical, afterwards in a collected form under the title of Reisen (Stuttgart, 1853–54). This work has been translated into English. In 1860 he set out on a third tour. On this occasion he went to South America, with the special purpose of visiting the German colonies there. The fruit of this journey was his Achtzehn Monate in Südamerika (Leipzig, 1862). In 1862 he accompanied Duke Ernest of Gotha in his journey to Egypt and Abyssinia, and on his return took up his residence at Gotha until 1867, when he set out on new travels to the United States, Mexico, Ecuador, Venezuela, and the West Indies. These he described in his Neue Reisen (Leipzig, 1868). The rest of his life was passed partly at Dresden, partly at Brunswick. Besides the works already mentioned Gerstäcker is author of various romances, the scenes of which are laid in different parts of the world. These include Die beiden Sträflinge (Leipzig, 1856); and Im Busch (Jena, 1864), the scene of which is in Australia; Tahiti (Leipzig, 1854), the scene of which is laid in the islands of the Pacific Ocean; Unter dem Aequator (Leipzig, 1861), in Java; General Franco (1865), in Ecuador; Sennor Aguila (1865), in Peru; Die Colonie (Jena, 1864), in Brazil; Californische Skizzen (Leipzig, 1856); and Gold (1858), in California. He lays the scene but rarely in his native land. Among the few of this class are Das alte Haus (Leipzig, 1857); Eine Mutter (Jena, 1867); Der Erbe (1868); Im Eckfenster (1871). Among his works for the people are his Nach Amerika (Leipzig, 1855), and In Amerika (1871); and among those for the young his Die Welt im kleinen für die kleine Welt deserves special mention. Besides the above works he also published several volumes of short tales under various headings. Nearly all his novels have been translated into Dutch and English, and a considerable number also into French.

GERSTENBERG, Henry William von, was born in 1737 at Tondern, in Schleswig, and died November 1, 1823. He was employed in the Danish service, both civil and military. His mind was formed by intercourse with Klopstock, Cramer, Sturtz, &c. He was once the favourite of his nation, and was distinguished for his writings, critical and poetical. He wrote many songs and several tragedies. His Ugolino was successful, even on the stage.

GERUND, the name given in Latin grammar to the forms which serve as the oblique cases (genitive, dative, accusative, and ablative) of the infinitive active; as *amandi*, of loving, *amando*, in or for loving, from the verb *amare*, to love. A corresponding adjective form is known as the *gerundive*: *amandus*, that ought to be loved. Corresponding forms in other languages are similarly named.

GERVAISE (or Gervase) OF TILBURY, a chronicler of the twelfth and thirteenth centuries, born probably of a family of distinction at Tilbury in Essex about the middle of the twelfth century. Having laid the foundation of his various scholarship by the study of theology, the canon law, and ancient classical literature, he betook himself to the court of Henry II. of England, who was a great lover and fosterer of the arts and sciences. He was appointed to attend on the young Prince Henry either in the capacity of tutor or adviser. Upon the death of the prince, whom he regarded with great affection and admiration, he went to Italy, and first taught the canon law at the University of Bologna. Afterwards he went to Lower Italy, where in 1189 he was appointed to some office of state by King William II. of Sicily. After the premature death of this sovereign he went to the court of Otto IV. of Germany, with whom he had become acquainted probably at the court of Richard Cœur de Lion, the uncle of Otto. Here his learning and ability were duly appreciated, and he was appointed by the emperor marshal of the Kingdom of Arles, which at that time appertained to the German emperors. Gervaise now took up his residence at Arles, where he remained at the latest till the overthrow of Otto at the battle of Bovines in 1214. After this event it is probable that he was recalled, and the researches of Hoffmann, the keeper of the archives at Brunswick, make it likely that he was subsequently appointed notary and chancellor to the young Duke Otto of Brunswick-Lüneburg, nephew of the emperor, but that he soon after, in consequence of his advanced age, resigned this appointment, and became overseer of a nunnery at Ebsdorf. He is said, on the same authority, to have died about 1235. Other writers place his death about 1218, and believe that he died in England. His chief and only extant work is Otia Imperialia, a work of varied contents, one portion of it giving an account of Britain and of the kings of England down to the time of the writer.—Gervase of Canterbury flourished about the same time. He wrote a chronicle dealing with English history in the twelfth century, a history of the archbishops of Canterbury, &c. His works were edited for the Rolls Series by Bishop Stubbs (1879–80).

GERVINUS, Georg Gottfried, a celebrated German historian, born at Darmstadt May 20, 1805; died at Heidelberg March 18, 1871. Having acquired a strong liking for literary pursuits he quitted the mercantile employment in which he was engaged, and in 1825 went to the University of Heidelberg, where the lectures of Schlosser inspired him with a peculiar love of historical studies. In 1828 he became a teacher in an educational establishment at Frankfort, but soon returned to Heidelberg, where he qualified himself as a lecturer with an essay entitled Geschichte der Angelsachsen im Ueberblick, without, however, delivering any lectures. In 1831 he visited Italy, where he remained for a year collecting materials for the works he was meditating. His Historische Schriften, published after his return (Frankfort, 1833), excited the attention of scholars, and secured him in 1835 an extraordinary professorship in the University of Heidelberg. In the following year (1836) he was appointed ordinary professor of history and literature at Göttingen. This post, however, he did not long retain. Having signed the protest of the seven professors of the University of Göttingen against the constitution promulgated by the King Ernest Augustus in December, 1837, he was deprived of his chair, and required to leave Hanover within three days. Gervinus withdrew to his native town, and then to Heidelberg, whence he set out on a second visit to Italy. After a winter passed in Rome he again returned to Heidelberg, where he was in 1844 appointed to an honorary professorship, and where he resumed his lectures. From 1845 he took an active part on the liberal side in the movements then going on in Germany. It was at this period that he wrote his Mission der Deutschkatholiken and Die Protestantische Geistlichkeit und die Deutschkatholiken. In 1847 he founded in Heidelberg, in conjunction with Mathy,

Mittermaier, and Häussy, the Deutsche Zeitung, which at once became one of the leading organs of the party which advocated a representative system for Germany and a clearly defined federal constitution. Having been sent to the federal diet by the Hanse towns he took part in the preparation of the Constitution of the Seventeen, and afterwards was returned to the National Assembly, over which he exercised great influence, not so much as a speaker, but by means of his journal. Discontented at the unfortunate turn which affairs took in 1848 he in August of that year withdrew from the National Assembly. After a residence of several months in Italy he again showed for a short time a lively interest in political matters, and wrote a series of powerful essays discussing the constitution question; but feeling again dissatisfied with the course that events were taking he gave up politics altogether and resumed his old studies. His chief works are Geschichte der poetischen Nationalliteratur der Deutschen (Leipzig, 1835–42), in which he endeavours to show how the development of German poetry is connected in all its phases with the history of the nation and other European countries; Shakspeare (Leipzig, 1849–50); and Geschichte des neunzehnten Jahrhunderts (Leipzig, vols. i.–viii. 1855–66) All his works, even his more purely æsthetical ones, such as that on Shakspeare, are more or less coloured by his political views and aims, and so much is this the case that he himself admits in the preface to the eighth volume of his History of the Nineteenth Century (which brings us down to the French revolution of 1830) that since events in Germany took a different course from that which he desired he no longer cared to complete the task of his life. In the last years of his life he zealously endeavoured to secure the popularity in Germany of the works of Handel, whom he regarded as the greatest genius in the musical sphere that the world had ever seen. His Autobiography appeared in 1893.

GERYON, in the mythology of Greece a king of Hesperia, son of Chrysaor and Callirrhoe, a three-headed giant. He possessed numerous and fine herds, which were guarded by the two-headed dog Orthrus and the giant Eurytion. The herds were carried away, and Geryon slain by Hercules, in obedience to the command of Eurystheus.

GESENIUS, Friedrich Heinrich Wilhelm, a distinguished orientalist and biblical critic, born in 1786, at Nordhausen, in Prussian Saxony, was educated in its gymnasium, and afterwards studied at the Universities of Helmstedt and Göttingen. In 1806 he was appointed theological repetent (tutor) in the latter, and in 1809, on the recommendation of Johannes von Müller, obtained the chair of ancient literature in the gymnasium of Heiligenstadt. In the following year he became extraordinary, and in 1811 ordinary professor of theology in Halle. In 1814 he obtained the degree of D.D., and in the summer of 1820 made a literary tour to Paris and Oxford, chiefly for the purpose of obtaining lexicographical collections in regard to the Semitic languages. Notwithstanding the suspicion and hostility which he incurred with the orthodox party, particularly in 1830, along with his friend Wegscheider, he conferred essential service, not only as a writer, but also, and more especially, as a teacher, by his rare talent for communicating knowledge, and is entitled to be regarded as the founder of a new era in regard to the lexicography and grammar of Hebrew and of the Semitic tongues generally. He died in 1842. His principal works are a Hebrew and Chaldee Dictionary, Critical History of the Hebrew Tongue and Literature, Translation of the Prophet Isaiah, and Thesaurus Linguæ Hebrææ, of which last there is a remodelled English edition by Brown, Driver, & Briggs. Of his well-known Hebrew Grammar, as thoroughly revised and enlarged by Kautzsch (Leipzig, 1896), an English translation appeared in 1898.

GESNER, Johann Matthias, a German scholar, born at Roth in Anspach, in 1691, and died in 1761, at Göttingen. After he had completed his studies at Jena he became, in 1715, co-rector and librarian at Weimar; in 1728 rector of the gymnasium at Anspach; in 1730 rector of the school of St. Thomas at Leipzig; and in 1734 professor of rhetoric and subsequently librarian in the newly-erected University of Göttingen. He laboured with equal judgment and zeal to improve the course of instruction and the study of the ancient languages. By his editions of the ancient writers on agriculture, of Quintilian, Pliny the Younger, Claudian, Horace, and Orpheus, he introduced an instructive mode of illustrating the ancient classics, and by his Primæ Lineæ Isagoges in Eruditionem universam, he prepared the way for a general study of the sciences. His Ciceronian and Plinian Chrestomathies are useful school-books. He rendered service to the study of the Roman language and literature by his edition of Faber's Thesaurus, and still more by his New Thesaurus of the Roman Language and Literature (Leipzig, 1749, four vols. fol.), in which he collected the whole vocabulary of the Latin language.

GESSLER. See Tell.

GESSNER, Konrad von, surnamed the *Pliny of Germany*, was born of poor parents, at Zürich, in 1516, where he studied, as also at Strasburg, Bourges, and Paris, and was a schoolmaster in his native town. Hoping to raise himself from his needy condition he went to Basel, and devoted himself particularly to the study of medicine. He became afterwards professor of the Greek language at Lausanne, and after a short residence at Montpellier he was made professor of philosophy, and practised as a physician at Zürich, where he died of the plague in 1565. Medicine, philology, and the history of literature were his departments. He commenced his labours in the last branch by his Bibliotheca Universalis, a full catalogue of all writers extant in three languages, Greek, Latin, and Hebrew (Zürich, 1545). This work is a monument of immense learning and industry. Natural history was awakened by him from its slumber of centuries. He collected matter in every quarter, either from his own observations or from the works of the ancients. His history of animals must be regarded as the foundation of modern zoology (Hist. Animalium, Zürich, 1551–87, four fols. fol.) He also rendered a service to science by a complete translation of Ælian. As a botanist he surpassed all his predecessors or contemporaries. He travelled through almost all parts of Europe, to see and to collect, established, notwithstanding his slender resources, a botanic garden of rare plants, supported an artist to draw and paint, and formed the first cabinet of natural history. He was the inventor of botanical arrangement, since he distributed the vegetable kingdom into classes, genera, and species, according to the characters of the seeds and flowers. The medicinal properties of plants were not neglected by him, and he made experiments first upon himself and then upon others.

GESSNER, Salomon, a German poet, author of the Death of Abel, was born at Zürich in 1730; died there 1788. His father was a bookseller and a member of the great council at Zürich. He was intrusted to the care of a country priest, after it was found that his early education had not awakened his intellect. Here his mind, hitherto depressed by mortifying censures, was aroused. He made advances in

the Latin language, and his intercourse with his instructor's son, who read the best German writers, as well as the beauty of the surrounding country, developed his natural disposition to poetry. After two years he returned to his friends. His intercourse with the most eminent scholars in Zürich served to correct and extend his knowledge, and to enlighten his conceptions. Gessner's father desired that he should undertake the business of a bookseller, and sent him in 1749 to Berlin, that he might prepare himself for this occupation. He entertained, however, so decided a dislike for the business that he left his master. As his father endeavoured to compel his return by withholding the money necessary to his support, he maintained himself by executing landscapes, which were well received. In 1762 he published, in four volumes, the poems which he had previously given to the world on different occasions. In 1772 he published another volume containing a collection of poems, to which he gave the name of Idyllen (idyls), a name which he had already given to a previously published volume of poems. Their quiet amiable character pleased many in Germany; and in France, where they were translated by Huber, they were received with enthusiasm, and the author was regarded as a poet of the first rank. From France his fame spread over all Europe. The most popular of his idyls is the Death of Abel, which has been translated into many foreign languages. A certain tenderness and a melodious language are the sources of the success of Gessner's writings; but he is deficient in depth and strength. In landscape painting he has merits which no age will diminish. His etching is light and powerful; his views are select, wild, and romantic; and his trees are particularly fine. Twelve engraved landscapes, published in 1770, are considered among his best works. Various editions of his works have appeared, among which we may mention that published in 1841, at Zürich, in two vols.

GESTA ROMANORUM (Deeds of the Romans), the usual title of a collection of short tales which was very popular towards the close of the middle ages. It has been the subject of much literary and historical investigation, and separate works have been devoted to it by Warton, Douce, Swan, Grässe, Wright, and others, while many other scholars have made incidental notices of it and questions connected with it. The result of all these researches is, however, as yet very meagre. There can be no doubt that the original text was a Latin one, but the Latin texts which exist, either in manuscript or in a printed form, differ very much among themselves. The manuscript Latin text which is most widely distributed in England is regarded as a purer one than those found on the Continent, inasmuch as it contains none of the moral reflections which are supposed to have been added by later hands, and which are contained in the latter. This text is said to have been compiled in England about the time of Richard II. (end of fourteenth century). It has never been printed in the original Latin, but frequently in English translations. From the fact of the English Latin text being found in numerous manuscripts throughout the country, and in all identical, while the Continental MSS. are very rare, and differ from one another greatly, as if they were the result of arbitrary alterations made by different persons upon a common original, as well as from the fact that some tales which are not found in the continental printed editions are found both in the English Latin text and in some of the continental MSS., Wright infers that the English text is the original one, and that accordingly the Gesta Romanorum were compiled in England; but the truth of this supposition has never been proved. As to the author of the work as little is known as with regard to the original text. No author or compiler is named in the work itself, but several names have been given by later writers. Glass, writing in 1623, mentions a Petrus Berchorius (Pictaviensis) as having expounded allegorically and mystically the legends of the fathers and other old wives' fables in his book Gesta Romanorum, and from this Warton concluded that the author was Pierre Bercaire of Poitou, a Benedictine prior, who died in 1362; but from the way in which he is mentioned by Glass it seems more reasonable to infer that Berchorius or Bercaire merely added the moral reflections and allegorical interpretations to the tales, not that he was the author of the book. The names of Fulgentius and Helmannus were found by Dronke, a German bibliographer, mentioned by different authorities as that of the author of the Gesta; and Grässe discovered that it was ascribed in a work of a similar plan to the Gesta, first printed in 1480, to one Elimandus. Both Dronke and Grässe conjecture that the same person is referred to by the names Helmannus and Elimandus, and that the true form of his name was Helinandus; and it is to him that the authorship of the work is most generally ascribed. The time at which the book was written was most probably about the close of the thirteenth century. The separate tales making up the Gesta are of very various contents, and belong to different times and countries, and the sources from which they are derived are partly classical, partly oriental, and partly western. Whatever may have been the intention of the original compiler, they very soon were adapted to the moralizing tendencies of the time, and moral lessons being deduced from the separate tales, they soon became a favourite book for reading aloud in the monasteries, and a frequent source to which the clergy went for illustrations in their sermons. They were thus, during the fifteenth and early in the sixteenth century, frequently printed in Latin, French, English, German, and Dutch, until at last, on account of the Reformation and the spread of classical learning, they fell into oblivion, from which they were only drawn by the zeal of modern scholars. An English translation of this work was published by Wykyn de Worde; a revision of that of the Rev. C. Swan (London, 1824) is contained in Bohn's Antiquarian Library: a Latin edition is that of Oesterley (1872).

GESTATION (Latin, *gestare*, to bear), in physiology, the name given to the interval which elapses between the impregnation of any of the mammalia and the period of birth. The length of this interval varies in different species, but is, as a rule, constant in the same species. The following table gives an indication in days of the length of the period of gestation in various animals, as nearly as it has been ascertained:—

Mouse,	25	Lion,	110
Hamster,	28	Wolverine,	120
Squirrel,	28	Beaver,	120
Hare and Rabbit,	28 to 30	Sheep,	147
Rat,	35	Goat,	154
Dormouse,	35	Roe-deer,	165
Weasel,	35	Lama,	168
Ferret,	40	Bear,	210
Hedgehog,	48	Sapajou,	210
Cat,	56	Rein-deer,	230
Marten,	56	Elk,	270
Dog,	63	Cow,	286
Fox,	63	Mare,	300
Polecat,	63	Ass,	300
Lynx,	63	Zebra,	300
Otter,	63	Camel,	315
Wolf,	63	Rhinoceros,	540
Badger,	65	Elephant,	620

GETÆ, an ancient Scythian people of Europe, the same with the Daci. See DACIA.

GETHSEMANE (oil-press), an olive garden or orchard in the neighbourhood of Jerusalem, which was traversed by the road leading from the city across the brook Kedron to the Mount of Olives, and memorable as the scene of the last sufferings of our Lord. The traditionary site of this garden (fixed on, it is supposed, at the visit of Helena, the mother of Constantine, 425 A.D.) places it a very little beyond the Kedron, and quite near to the Church of the Virgin Mary, alleged to have been built over her tomb. Maundrell describes it in his day (1697) as 'an even plot of ground, not above 57 yards square, lying between the foot of Mount Olivet and the brook Kedron. It is well planted by olive-trees, and those of so old a growth that they are believed to be thesame that stood there in our blessed Saviour's time, in virtue of which persuasion the olives, and olive-stones, and oil which they produce, become an excellent commodity in Spain.' The trees referred to, now eight in number, are indeed of venerable antiquity, but the belief that they are the same that stood there in the time of Christ must be erroneous, if it is the case, as Josephus states, that Titus cut down all the trees within 100 furlongs of Jerusalem to furnish himself with materials for prosecuting the siege. This plot of ground has been bought by the Latin Church, and laid out as a European garden. The Armenian and Greek Churches, however, deny that this is the actual site, and have fixed upon another a little to the north, not so close to the city, and more capable of affording the secrecy which Christ sought when he retired with his three disciples, Peter, James, and John, to the garden where he suffered his last agony. Even the site selected by the Greek and Armenian Churches is thought by many judicious explorers to be too near the city to answer the requirements of the evangelical narrative, and they think it is necessary to fix on some spot probably several hundred yards further up the valley. It is plain, however, that the materials are wanting for enabling any one to decide with certainty upon the precise spot.

GEYSERS, a name derived from an Icelandic word signifying 'to burst forth with violence,' and applied to natural springs of hot water of the kind that were first observed in Iceland. They may be described as volcanoes of hot water, for they resemble volcanoes in every particular—in the vibrations of the earth and dull rumbling sounds or loud reports by which the eruptions are preceded, in the intermittence of the phenomenon, and in the form of the opening at which the eruptions take place, like an inverted cone with a deep central throat. Natural philosophers are not agreed as to the mode in which this phenomenon is to be explained, but the most generally prevailing and most probable hypothesis is that it is caused by the disengagement of large quantities of vapour, which force the water up into the air when the successive disengagements have produced a sufficient pressure. This explanation is so widely received that it may almost be regarded as established; and the chief point on which natural philosophers are still undecided is as to the manner in which the great quantities of steam are collected and temporarily confined by the water.

The geysers of Iceland lie about 30 miles N.N.W. of Mount Hecla, and 16 miles north of the town of Skalholt, in a plain covered by hot-springs and steaming apertures. They are nearly 100 in number, and are scattered over a surface scarcely more than 2 square miles in extent. The two most remarkable are the Grand Geyser and the New Geyser or Strokkur (churn). The Great Geyser rises from a tunnel-shaped basin, lined and edged with silicious deposits. The pipe or throat at the bottom, from which the jet issues, is about 10 feet in diameter, and the basin at its outer edge is above 70. The emissions generally take place at intervals of six hours, and last for about five minutes at a time. The column, as measured by a quadrant, has been seen to rise as high as 212 feet. It is impossible to fix the age of the Great Geyser, but that its eruptions have taken place from the most remote antiquity is proved by the fact that, although there has been no sensible increase in the depth of the silicious deposit since the earliest recorded observations, it is now more than 16 feet deep. The Strokkur, situated within a very short distance of the Great Geyser, is much inferior in size, the crater being only from 6 to 8 feet in diameter at its outer edge. It still contains boiling water, but eruptions no longer take place. As long as it remained active its eruptions were even more remarkable than those of the Grand Geyser, on account of the extreme magnificence of the light effects. The temperature of the water emitted by the Icelandic geysers frequently exceeds boiling-point.

The geysers of Iceland, long the only ones known to exist, are surpassed by those which have been discovered in comparatively recent times in the Rocky Mountains in the Yellowstone and Firehole Basins, in the Yellowstone National Park, state of Wyoming, U.S. Those in the Firehole Basin are described by explorers with special enthusiasm. The largest of them is called the Grand Geyser. It begins an eruption by filling its basin with boiling water, forming a well 20 by 25 feet in diametric measurements, and having a visible depth, when quiet, of 100 feet. The explosion is preceded by clouds of steam rushing up to a height of 500 feet; the great unbroken body of water succeeds, ascending in one gigantic column to a height of 90 feet; while from the apex of the column there radiate five great jets, which shoot up to the unparalleled height of 250 feet from the ground. Among the other remarkable geysers of this district are those named Old Faithful, the Beehive, the Giant, the Giantess, &c. All the writers who describe this region dwell with delight on the exquisite beauty and variety of the mineral and metallic sediments deposited by the hot-springs and geysers. The number of hot-springs of all kinds in the Firehole Basin alone is not less than 1500, all varying in times of action, force, deposits, and colour of water.

GHADAMES, a district in North Africa, situated on the north frontier of the Sahara, and forming the south-west frontier of the Regency of Tripoli. It comprises three oases—Ghadames proper, Derge, and Seenawan, each of which has a capital of its own name. The area of the whole district is estimated at 1200 square miles. Beyond its limits the whole of the surrounding region is purely desert, consisting of ridges and sandhills, with waterless intervening valleys, and in geological structure of horizontal strata of sandstone and limestone. Ghadames proper, owing to the precarious fall of rain, draws its supplies of grain from Derge and Seenawan, which are better situated for raising corn; and devotes itself chiefly to trade, for which the inhabitants show a decided aptitude. It is carried on extensively with Tripoli on the one hand, and Ghat, Kano, Timbuctoo, Tuat, and other parts of the interior, on the other. From the interior are brought ivory, bees'-wax, hides, goat-skins dyed red and yellow, ostrich-feathers, gold in lumps and dust, guru or kola nuts, cottons, &c.; from Tripoli, cotton and long cloths, and tangibs, all of British manufacture; red-dyed raw silk and beads from Venice; woollen cloths and red caps from Tunis; with other articles from various sources. The Turks have no firm hold on this part of Tripoli, which the French have long looked on with covetous eyes. The aggregate population of the district is computed

at 12,000.—The town of Ghadames, situated about 310 miles S.S.W. of Tripoli, with about 7000 inhabitants, is the meeting-place of all the caravan routes between the north coast of Africa (except Morocco) and the interior, and is the great trading centre of that region. As early as the eleventh century it was celebrated for its leather wares, and at the present day produces the best shoes in the north of Africa.

GHARA, or GARRA, a river in the Punjab, being the name by which the united streams of the Bias and Sutlej are known, from their confluence near Sobraon to the junction with the Chenab. The length of course between these two points is about 300 miles. It is remarkably direct in its general course, which is south-west, but tortuous at short intervals. Its breadth at Hurelee, a little below the junction by which it is formed, is 275 yards at the lowest season, and 12 feet deep, running at the rate of 2½ miles an hour.

GHAUTS, or GHÁTS (literally 'passes'), two ranges of mountains in the peninsular portion of Hindustan, called the Eastern and Western Ghauts; the former bounding the table-land of the Deccan on the east, the latter on the west. They are in general composed of granite, and also contain a quantity of iron-ore. The Western Ghauts extend from Cape Comorin on the south to the Tapti River on the north, or about lat. 21° N., a distance of about 1000 miles; nearly parallel to the coast, which they approach much more closely than the Eastern Ghauts, the distance not often exceeding 50 miles. This range varies considerably in elevation, the highest peak being estimated at 8760 feet. Their width is inconsiderable, rarely exceeding 12 miles. With exception of a few places where the rocky masses are too steep to permit any accumulation of earth, they are covered with stately forests of teak and other large timber. Bamboos and the ground rattan also abound here, and attain a size which they reach nowhere else. A great deal of beautiful and highly picturesque scenery occurs in these mountains, enhanced by numerous magnificent waterfalls. One at Kalliani, north from Poonah, is about 1400 feet high. The Eastern Ghauts commence in the south, about lat. 11° 20′ N., to the north of the Kaveri; and extend, with little interruption or comparative deviation from a straight line, to the banks of the Kistnah, in lat. 16° N., separating the low and level country along the Bay of Bengal from the table-land in the interior. They consist of a number of mountain ridges running parallel to one another in their general direction. They are of considerably less elevation than the Western Ghauts, and their average height may be stated at 1500 feet. Their average breadth is about 50 miles. They have none of the picturesque beauty of the Western Ghauts; their surface being very stony, dry, and exceedingly broken, and nearly destitute of trees, with exception of a few tracts covered with wild dates. The Eastern Ghauts are in some parts rich in metals; iron is very abundant, and copper and lead are worked in several places, and diamonds are occasionally found.

GHAZIPUR, a town in Hindustan, in a district of the same name, in the United Provinces, on the left bank of the Ganges, in the division of Benares, and 44 miles north-east of the town of Benares. It is situated on a low-lying alluvial tract of land, and presents a mean appearance, being principally composed of ruined houses and ghauts and mud cottages fringing the river for about 3 miles, with a breadth of not more than ½ mile. The edifice that is most worthy of notice is the old palace known as the Palace of the Forty Pillars, built on a basement story of great height rising from the Ganges. It is approached from the town by a handsome Gothic gateway, still in tolerable repair; the blue, red, and white mosaic pavement is partly entire, and many of the pillars are still remaining. Some tombs of former rulers may also be mentioned. There is also here a monument erected to the memory of Lord Cornwallis, who died here in 1805. It consists of a domed building, containing a marble statue by Flaxman. The headquarters of the opium department for the United Provinces are here. The industries embrace sugar, tobacco, cottons, and rose-water. The district is mostly alluvial, and nearly all fertile and cultivated. Area, 1473 square miles; pop. 1,077,909. Pop. of town in 1901, 39,186.

GHAZNA, GHUZNEE, or GHIZNI, an ancient and celebrated city and fortress in Afghanistan, 84 miles S.S.W. Cabul, on an eminence forming the western extremity of a range of hills stretching east and west, 7726 feet above sea-level. The city contains about 1500 houses, usually two stories high, and is surrounded by walls strengthened with numerous bastions and surrounded by a trench. The citadel, which is towards the north, occupies an eminence overlooking the town, and presents a very imposing appearance; but being in turn commanded by the neighbouring hills, is not so formidable as it looks. There are four bazaars in the city, but of a very inferior description, being covered merely with mats and wood. In consequence of the elevated position of Ghazna, the cold is intense in winter; while the snow-storms are sometimes so severe, it is said, as to have destroyed the population several times. Notwithstanding this the country around is productive in grain and fruits, the apples and prunes of Ghazna being much celebrated. 3 miles north-east are the ruins of the ancient city, which, in the eleventh century, under the dynasty of Ghaznavides, and more particularly under the celebrated Sultan Mahmud (999–1030), was the capital of an empire reaching from the Tigris to the Ganges, and from the Jaxartes to the Persian Gulf. Ghazna was taken by storm by the British troops in 1839. Upon the insurrection in 1841 it again fell into the hands of the Afghans, from whom it was recovered in 1842, and the citadel destroyed. During the Afghan war of 1879–80 it was twice visited by British forces under Sir Donald Stewart and Sir Frederick Roberts.

GHEE, or GHI, a peculiar kind of butter in use among the Hindus. It is made in the following manner:—The milk when brought from the cow is poured into earthen vessels, in which it is boiled for one hour or less, often for two or three hours. It is then put in a cool place, and a little curdled milk is added. By the next morning the whole is converted into sour curdled milk. A layer 5 or 6 inches deep is then taken off the top of the contents of each vessel, and is put into another larger vessel, in which the whole mass is gently stirred for half an hour with a split bamboo-cane. A little warm water is then added, and the stirring is continued for another half-hour, when the butter begins to form. After being kept for three days—a period long enough for the butter to become rancid in so hot a climate—it is melted in another earthen vessel, and boiled until all the water it contains is evaporated. A little more curdled milk is then added, along with some salt or betel-leaves, and the butter, which is now ready, is then put in pots, in which it is kept till required. In this state it will keep for a long time, being sometimes used a year after it is made. This butter has naturally a very strong taste, but though insupportable to a European stomach, it is in general use among Hindus who are rich enough to buy it, and is an important article of commerce throughout a large part of India.

GHEEL, a town and commune in Belgium, in the province of Antwerp, 28 miles south of Turnhout, on the Greater Nethe. It has several churches, among them the interesting one dedicated to St. Dymphna; manufactures of cloth, hats, wax and tallow candles, &c.; tanneries, dye-works, ropeworks, &c., and a considerable trade in butter. The commune is remarkable for containing a colony of deranged persons, who are lodged and boarded in the houses of the country people, who make use of their services, when available, in field and other labour. Little or no restraint is employed, and the best effects thence ensue. Pop. (1900), 13,340.

GHENT (French, *Gand*; Flemish, *Gend* or *Gent*), a town in Belgium, capital of the province of East Flanders, in a fertile plain at the confluence of the Lys with the Scheldt, on the Ghent-Terneuzen Canal, which communicates with the sea, and admits large vessels, and on the railway from Ostend to Brussels, 31 miles N.W. of Brussels. It occupies an area over 6 miles in circumference, part of which is covered by gardens, while the walls which inclosed the city have given place to promenades. The most striking feature is the great number of canals which branch off from the Lys in all directions, and, forming a kind of net-work within the town, divide it into twenty-six islands, communicating with each other by an immense number of bridges. Another striking feature is the number of fine promenades, of which the most remarkable is the Coupure, formed by rows of trees along the Bruges Canal. The town is on the whole well built. In some of the older parts the streets are often dark, and so narrow that two carriages can scarcely pass; but in the other quarters the streets are in general straight and spacious, with rows of handsome houses fronting canals inclosed by magnificent quays; and there are a great number of squares. Near the square called the Marché-du-Vendredi there is an enormous cannon, 18 feet long, 10 feet in circuit, and nearly 3 feet wide at its mouth, formed of hoops and bars of iron, and surnamed Dulle Griete (Mad Meg). In the centre of the square is a colossal statue of Jacob van Artevelde. The principal buildings are the cathedral of St. Bavon, a vast structure, somewhat heavy in its exterior but within finely proportioned and richly decorated, possessed of a large crypt (dating from the tenth century), a beautifully-carved pulpit, many interesting monuments and fine paintings, and surmounted by an elegant tower 272 feet high; the church of St. Nicholas, the oldest in Ghent; the church of St. Pierre, last restored in 1629–1718; the church of St. Michael, with a celebrated Crucifixion by Vandyk; the church of St. Jacques, with several pictures; the university, a handsome modern structure, with a library of about 100,000 volumes and 700 MSS.; the Institute of the Sciences, completed 1890; the Hôtel-de-Ville, a recently-restored sixteenth-century building; the custom-house or Hôtel-de-l'Octroi; two large nunneries (Béguinages) of the thirteenth century; the belfry, a lofty square tower surmounted by a gilded dragon, and containing a fine set of chimes consisting of forty-four bells; the casino; a prison, known as the Maison de Force, and another known as the Maison de Sûreté; the new Palais-de-Justice; two conventual establishments; and the royal academy of art. There is also a botanic garden.

Ghent has long been celebrated as a manufacturing town. In the twelfth century it was famed for the excellence of its woollen goods. The extent to which the cotton manufacture is now carried on in Ghent has procured it the surname of the Belgian Manchester. The other manufactures of importance are jute, refined sugar, common and table linen, woollen cloth, flannel, serge, silk, lace, thread, ribbons, hoisery, wax-cloth, oil, chemical products, armour, physical, mathematical, and surgical instruments, articles in steel, bronze, and crystal, carriages, paper, hats, delft-ware, tobacco, blue, starch, &c. There are also extensive machine-works, roperies, tanneries, breweries, and distilleries. The trade in corn, oil, seeds, wine, bulbs, and Flemish linen is very important. The Terneuzen canal has been much improved of late, and increased dock accommodation has been provided.

The origin of Ghent is uncertain. It is first mentioned as a town in the seventh, but does not appear to have acquired much importance till the twelfth century, when its fortifications were completed. By the end of the thirteenth it was nearly as large as at present In the bloody feuds which agitated Flanders up to the middle of the fourteenth century Ghent took a leading but not always a successful part, and repeatedly, by the turbulence of its citizens, provoked a fearful retribution. The most successful of its revolts up to this period was that under Jacob van Artevelde, during the seven years of whose dictatorship (1338–45) it attained a high degree of prosperity. In 1369, when the county of Flanders passed by marriage to the house of Burgundy, Ghent followed its fortunes, but shortly afterwards revolted under Philip van Artevelde, the son of Jacob; and notwithstanding severe reverses, in one of which it lost 20,000, and in another 16,000 of its citizens, scarcely ceased to be prosperous. The spirit of revolt, however, was subdued; and Charles the Bold was peacefully inaugurated at Ghent in 1467. In 1537, when an extraordinary subsidy was demanded of the inhabitants by Mary of Austria, who then governed the Netherlands in the name of Charles V., they broke out in open resistance. Severe punishment soon followed, and the citizens, besides losing their privileges, were obliged to pay for the erection of a citadel, intended to keep them in bondage. In 1678 Ghent was taken by Louis XIV. after a siege of six days, but was restored to Spain by the Treaty of Nimeguen. It was occupied by Marlborough in 1706, after his victory over the French at Ramillies. In 1745 it was surprised and taken by the French, and it was again taken by the French in 1792. From 1796 to 1814, under the French Republic and the French Empire, it was the capital of the department of Escaut (Schelde), and during the existence of the united kingdom of Holland and Belgium was what it still is—the capital of the province of East Flanders. The war of 1812–14 between Great Britain and the United States was put an end to by a treaty concluded here on the 24th of Dec., 1814. Ghent is the birthplace of John of Gaunt and the Emperor Charles V. Pop. (1900), 160,949.

GHERARDESCA, a family which plays an important part in the history of the Italian republics of the middle ages. It originated in Tuscany, where the counties of Gherardesca, Donoratico, and Montescudaio (in the Maremme between Pisa and Piombino) belonged to it. About the beginning of the thirteenth century the counts of Gherardesca united themselves with the powerful and rich Republic of Pisa, and placed themselves at the head of the people in opposition to the aristocracy. In the great contest between the Ghibellines and Guelfs they joined the former, who supported the Suabian emperors. Two of this family—the counts Gherardo and Galvano Donoratico—accompanied Conradin of Hohenstaufen in his unfortunate expedition to Naples, and died with him on the scaffold in 1268. This adherence to the interests of the emperors involved the Gherardescas, as early as 1237, in hostilities with the Vis

conti, who belonged to the party of the Guelfs; and all Pisa was divided between the two parties. At length the head of this powerful family, Ugolino Gherardesca, resolved to make himself master of his native city (Pisa). Being first magistrate in the republic, and head of the Ghibellines in the city, he expected to find but little difficulty in attaining his object. Contrary, however, to the politics of his house and the spirit of his age, he so far coalesced with the Guelfs as to give his sister in marriage to Giovanni Visconti, the chief of the Guelfs in Pisa. The plan, however, was discovered, and both Visconti and Ugolino were banished. The former armed the Guelfs against Pisa, but his early death at San-Miniato freed the republic from its dangerous adversary. But Ugolino joined the Florentines and the people of Lucca, at the head of whom he gained several victories over the Pisans, and compelled them to recall him in 1276. Returning to his former plans he endeavoured to secure the friendship of the Ghibellines in the city as well as that of the Guelfs abroad, and his prudence and riches enabled him to succeed but too well. The once vigilant republicans suffered themselves to be lulled into security, and in 1282 the war with Genoa, so unfortunate for Pisa, afforded Ugolino an opportunity for breaking the power of the people. In the battle of Meloria (Aug. 6, 1284), memorable for the final destruction of the Pisan fleet, in which 11,000 Pisans were made prisoners by the Genoese, Ugolino betrayed his country, and by his premeditated desertion gave the signal for general flight; the rest, giving up all for lost, followed him in confusion. The old enemies of Pisa, the Florentines, Luccanese, Siennese, the cities of Pistoia, Prato, Volterra, San-Geminiano, and Colla —in a word, all the Guelfs of Tuscany—on receiving intelligence of this misfortune determined, by a decisive blow, to annihilate the ancient city of Pisa, the principal support of the Ghibellines in Italy. The state, on the brink of destruction, now saw itself compelled to throw itself into the arms of him whose treachery had reduced it to this situation. Ugolino, for a long time secretly connected with the chiefs of the Guelfs, undertook the negotiation with the enemies of the city, which he managed in such a manner that he at length saw himself almost at the summit of his wishes. The leaders of the Ghibellines were banished; the Florentines took possession of many castles; and Ugolino, under the protection of the enemies of Pisa, ruled the fallen state (1285). He reduced it still further by the surrender of certain castles to the Luccanese, which gave them access to the gates of the city, and by avoiding the conclusion of a peace with Genoa, which would have set at liberty the prisoners captured at Meloria. While he thus oppressed his native country, and gratified his hatred against his enemies by banishing them, a conspiracy was formed against him in his own family. Nino di Gallura, his nephew, disgusted with his tyranny, united the principal families both of the Ghibellines and Guelfs, the Gualandi, Sismondi, Lanfranchi, and others, to rescue Pisa from the degradation into which she was sunk. After a contest of nearly three years the intrigues of Ugolino succeeded, with the assistance of the Archbishop of Pisa, Ruggiero de' Ubaldini, in dissolving this league and regaining the Ghibellines. The Lanfranchi and others forsook Nino di Gallura, who was banished, together with many of his friends. Ubaldini was rewarded for his services by being driven from the public palace by Ugolino, who had promised to share with him the Dominion of Pisa. The ambition of the usurper now knew no bounds. The people were oppressed, the lives of his own relations were threatened, and he murdered with his own hands a nephew of the archbishop. Such crimes united all against him; and Ubaldini, no less ambitious, artful, and cruel than Ugolino, was at the head of the conspirators. He artfully concealed the plan from the tyrant till it was fully matured, and Ugolino's refusal to finish the war with Genoa afforded the opportunity for the breaking out of the conspiracy. On the 1st of July, 1288, Ubaldini caused the alarm-bell to be sounded. Ugolino was attacked on all sides, and after an obstinate resistance, which continued till evening, was made prisoner, with two of his sons, Gaddo and Uguccione, and two of his grandsons, Nino, surnamed *Le Brigata*, and Aurelio Nuncio. These are the five persons whose horrible death Dante describes in his Inferno. Ubaldini caused these unfortunate persons to be carried to the castle of Gualandi, since called *Torré della Fame*, and, setting no bounds to his vengeance, threw the keys into the Arno, and doomed the prisoners to die by hunger. Poets and artists have often described or represented the terrible end of Ugolino and his companions, and posterity has forgotten his crimes in his horrible punishment. Many of the family of Ugolino were either absent from Pisa, or escaped by flight from this dreadful catastrophe, so that the family of Gherardesca soon recovered its former splendour and distinction both at home and abroad, and in 1320 we find Neri della Gherardesca at the head of the administration in Pisa. A natural son of his, Fazio Manfredi della Gherardesca, at the head of the Pisanese garrison, defended Cagliari with a very inferior force against Alfonso IV. of Arragon, and at the battle of Luco Cisterna, on the 28th of Feb. 1324, in which the Pisans were completely routed, he succeeded in making his escape to Cagliari with about 500 followers. The Arragonese did not succeed in taking Cagliari till after his death, which took place in consequence of wounds received in a sally. Another Gherardesca, Bonifazio, was made *capitano* of Pisa in 1329, when that city shook off the yoke of the celebrated Castruccio Castracani and of the Emperor Louis of Bavaria. His wisdom and integrity gained him the love of his fellow-citizens, and the city was indebted to him for the advantageous peace which it soon after concluded with its old enemies the Guelfs. He also suppressed a conspiracy of the nobility against the people (1335), and compelled the conspirators to leave the city. In 1340 he died of the plague, and the grateful Pisans appointed his son Raynerio, then only eleven years of age, his successor in the office of capitano. In 1348 Raynerio also died of the plague, by which the Gherardesca family lost many of its members: the rest withdrew to the family estates in the Maremme, and took little share in the political transactions of Pisa. Filippo Gherardeschi, born at Pistoia in 1730, a distinguished musical composer and pianofortist, was another descendant of this family. He studied, while young, with P. Martini at Bologna, and in a short time became his most distinguished pupil. He died at Pisa in 1808.

GHIBELLINES. See GUELFS AND GHIBELLINES.

GHIBERTI, LORENZO, a statuary, born about 1378, at Florence. His ancestors had distinguished themselves in the arts, particularly in that of the goldsmith, in which the Florentines had acquired great celebrity. He early learned from his stepfather Bartoluccio, an expert goldsmith, the arts of drawing and modelling, and that of casting metals. He afterwards probably enjoyed the instructions of Starnina. Being obliged to leave Florence on account of the plague which prevailed there at the end of the fourteenth century, he was engaged in painting in fresco at Rimini, in the palace of Prince Pandolfo Malatesta, when the priori of the society of merchants at Florence invited artists to propose

models for one of the bronze doors of the baptistery of San Giovanni. The offering up of Isaac was to be executed in gilt bronze, as a specimen of the work. The judges selected the works of Donatello and Ghiberti as the best (according to Vasari, also that of Brunelleschi, who is not mentioned by Ghiberti himself as one of the competitors); but the former voluntarily withdrew his claims, giving the preference to Ghiberti. After twenty-one years' labour Ghiberti completed the door, and, at the request of the priori, executed a second, after almost as long a period. Michel Angelo said of these, that they were worthy of adorning the entrance to paradise. During these forty years Ghiberti also completed a statue of John the Baptist for the church Or-San-Michele, two bass-reliefs for the baptistery of the cathedral of Sienna, a statue of St. Matthew, and one of St. Stephen, likewise for the church Or-San-Michele, and for the church Santa Maria del Fiore the bronze reliquary of St. Zenobius, bishop of Florence. All these works are still preserved, and serve to show the progress of Ghiberti. The dryness of the school of Giotto appears in his early works; the later are in imitation of the Greeks, and are marked by continually increasing vigour and firmness. The reliquary of Zenobius and the two doors of the baptistery of San Giovanni are, to this day, among the finest specimens of art in modern Italy. Ghiberti also executed some excellent paintings on glass for the churches Or-San-Michele and Santa Maria del Fiore. A work by him on sculpture is extant, a fragment only of which has been published by Cicognara. He died about the year 1455. The Kalmuck Feodor Ivanovich published twelve beautiful etchings of the doors of Ghiberti in 1798.

GHILAN, a province of Persia, on the south-west shore of the Caspian Sea; bounded on the N.E. by the Caspian Sea, E. by the province of Mazanderan, S. by Irak-Ajemi, N. by Russia, and W. by province Azerbijan; length, 70 miles; average breadth, about 50 miles. A lofty range of mountains, measuring from 6000 to 9000 feet above the level of the sea, forms its inland boundary. The capital is Resht. The whole province, except where cleared for cultivation, and on the mountain summits, is covered with woods, and the excessive rain and dense vegetation render the whole of the level country a morass. The climate is consequently unhealthy, and in the hot months fatal to Europeans. The province is rich in metals. The language of Ghilan proper is the Ghilaik, a dialect of the Persian. The inhabitants are represented as rude and brutal, much addicted to plunder and murder, and hardy, muscular, and active. The food of the Ghilaiks is very simple and light, consisting chiefly of rice and fish; but there is an abundance of fine poultry, and wild fruit grows profusely everywhere. The vines climb up the forest trees, as in Turkey; the juice of the grape affords a delicious kind of treacle, called *dowshawb*, which is eaten with dry boiled rice; wheat and barley are very sparely cultivated. The oak and birch flourish in the province, but the former does not attain to any noticeable dimensions. In the woods lurk the tiger and panther, the wild boar and the jackal; birds are very numerous; and the reedy marshes and islands are tenanted by myriads of wild-fowl. Enzelli is the only seaport of Ghilan, and its harbour is deep enough to admit vessels of 250 tons burden, but the passage is much obstructed by sand-banks. A considerable quantity of raw silk is exported, the average production being 9000 to 10,000 bales. Pop. of Ghilan about 200,000.

GHIRLANDAIO, DOMENICO, one of the older painters of Florence, born there in 1449, died in 1494. He distinguished himself as a painter in fresco and tempera, and a number of his greater works are still to be seen at Florence, in the Sassetti Chapel of the Santa Trinità church, in the choir of Santa Maria Novella, and elsewhere. Many of the prominent men and women of Florence had their portraits painted in his works. He had many pupils, among them Michael-Angelo and two of his own brothers. His son Ridolfo was a painter of some note.

GHIZEH. See GIZEH.

GHIZNI. See GHAZNA.

GHOST, HOLY, or HOLY SPIRIT, according to Trinitarians, the third person in the Holy Trinity; according to some theologians, a Biblical metaphor, used to designate the divine influence; according to others, the Deity himself, so far as He exercises an influence for spiritual and moral ends in general, and for the support and extension of Christianity in particular. The Roman Catholic Church, in speaking of the origin of the persons of the Godhead, declares the Son to be begotten by the Father, and the Holy Ghost to have proceeded from both; yet the Son and Holy Ghost are both eternal, since they are co-eternal with the Father. (See CREED.) This is the doctrine of the Athanasian creed, and was adopted also by the Lutherans and Calvinists. The Holy Ghost is equal to the other persons of the Trinity. (See TRINITY.) The Greek Catholic Church maintains that the Holy Ghost proceeds from the Father only; and this difference is one of the main points of distinction between that church and the Roman Catholic. The history of the controversy is shortly this: Tertullian and Origen, two distinguished fathers of the church in the third century, maintained that the Holy Ghost was begotten by the Father through the Son, and was superior to all other creatures. Macedonius, bishop of Constantinople in the middle of the fourth century, denied that the Holy Ghost was equal in essence and dignity to God the Father. The council of Alexandria in 362 declared this bishop and his adherents, the Pneumatomachists, teachers of heresy; and the general council at Constantinople in 381 declared expressly to the whole Christian Church, that the Holy Ghost was the third person of the Trinity, proceeding from the Father, and to be worshipped equally with the Father and the Son. Augustine taught that the Holy Ghost proceeds from the Father and the Son; and the Council of Toledo, in 589, condemned all who believed otherwise. This deviation from the former dogma occasioned a controversy, which lasted from the eighth to the eleventh century, between the Western or Latin, and the Eastern or Greek Churches, and finally led to their complete separation. The Western Church and the Protestants maintained that the Holy Ghost proceeds from the Father and the Son, while the Eastern Church asserted that he proceeds from the Father alone. The worship of the Holy Ghost as the third person in the Godhead is, however, common to both churches, and to the Protestant Trinitarians, being essential to the faith in the divine Trinity.

GHOST, HOLY, ORDER OF THE, an order of male and female hospitallers, founded by Guy, son of William, count of Montpellier, towards the end of the twelfth century, for the relief of the poor, the infirm, and foundlings. He took the vows himself, and gave a rule to the order. Pope Innocent III. confirmed the order in 1198, and founded an hospital in Rome, on which all the hospitals of the order on the Italian side of the Alps were dependent: all north of the mountains were dependent upon that of Montpellier. It is not known when the order began to admit females. They take care of young children, educate foundlings, and have several hospitals in France. The dress of both sexes was black, with a double

white cross of twelve points on the left breast. In 1672 it was united with the order of St. Lazarus; in 1708 re-established as a separate order; and after the middle of the eighteenth century re-united with the order of St. Lazarus by Clement XIII.

This is also the name of the principal military order in France, instituted Dec. 31, 1578, by Henry III. The knights were required to prove their nobility for three descents. The symbol of the order was a green enamelled cross with a white border, and having a white dove with expanded wings on a circular red ground in the middle. Between the branches of the cross there were golden lilies, and at the end of the branches there were golden knobs or pomels. On the reverse there was a representation in silver of St. Michael treading under foot the dragon. This symbol was usually attached to a broad blue ribbon, whence the order was commonly known in France as the *Cordon bleu*. The revolution of 1789 abolished this, with all the other orders; but it was revived under the Bourbons, and again abolished in 1830. A Neapolitan order of the same name was instituted by Louis of Anjou, king of Naples, in 1352.

GHUR, or GHOR, a town of West Afghanistan, 145 miles N.N.E. Dooshak; lat. 32° 58′ N.; lon. 63° 21′ E. It was at one time the capital of sovereigns whose power extended over Khorassan, Afghanistan, Scinde, and Lahore. The most distinguished of these sovereigns was Shahab-u-din in the latter half of the twelfth century. It was destroyed by Genghis Khan in the beginning of the thirteenth century, but afterwards rebuilt. It was again destroyed by Tamerlane about the end of the fourteenth century, and is now little more than a heap of ruins. Ghur is supposed to have been one of the earliest seats of the Afghan race.

GHUZNEE. See GHAZNA.

GIANIBELLI, or GIAMBELLI, FEDERICO, an Italian engineer, who acquired celebrity in the defence of Antwerp against the Spaniards in 1585. He is said to have been born at Mantua about 1530. Having offered his services to Philip II., king of Spain, he was induced to expect that he would soon receive employment from that monarch; but when his expectations were not realized as speedily as he thought proper, he took offence and repaired to England. Here he was favourably received by Queen Elizabeth, who gave him a pension, and instructed him to proceed to Holland to the assistance of the Dutch in the siege then preparing against Antwerp. Here, by means of the so-called 'infernal machines,' a kind of fire-ships containing explosive materials, he destroyed a bridge which had been thrown across the Scheldt by the besiegers, in order to cut off the communications of the besieged. He then made a breach in the dyke of Löwenstein with the purpose of compelling the besiegers to abandon their position. After this nothing more is heard of Gianibelli, although it is probable that he returned to England, where he is said to have devised the plan of using fire-ships against the Spanish Armada in 1588.

GIANNONE, PIETRO, an author equally celebrated by his fate and by his writings, born May 7, 1676, at Ischitella, in the province of Capitanata, in the Kingdom of Naples; died in the citadel of Turin, March 7, 1748. His talents gained him access to the house of the learned lawyer Gaetano Argento, in Naples, in which almost all the distinguished men of the capital were at that time accustomed to assemble. Here he conceived the plan of his most celebrated work, which determined the destiny of his whole life, his Storia civile del Regno di Napoli (four vols. 4to, Naples, 1723), in the composition of which he spent twenty years, and in which the work of Angelo di Costanzo, On Naples, served him as a guide. The severity with which Giannone treated the church, and the attacks which he made on the temporal power of the popes, drew upon him the persecutions of the court of Rome, and of the clergy in general. The offensive publication was burned, and the author excommunicated. Giannone therefore quitted Naples, 1723, and took refuge in Vienna. Here the protection of Prince Eugene, and the intercession of the Chancellor Zinzendorf, of Count Bonneval, who afterwards became so celebrated, and the Chevalier Garelli, then physician of the emperor, procured him a pension. The Emperor Charles VI. still, however, regarded him with a suspicious eye, and in 1734, when Don Carlos ascended the throne of Naples, not only was his pension taken from him, but he was obliged to leave Vienna. Giannone now withdrew to Venice, with the intention of continuing the work which he had already begun at Vienna—Il Triregno, ossia del Regno del Cielo, della Terra e del Papa, on which he spent twelve years. It is to be regretted that his misfortunes prevented him from completing it as he had proposed; he brought it down only as far as the ninth century. Some bitter satires against the Roman court, which he had written in Vienna, where the cardinal Pignatelli had released him from the excommunication, were, by the advice of his friends, not published. Giannone was favourably received in Venice, particularly by the senator Angiolo Pisani, but his prospects were soon changed. Having declined to enter into the service of the republic as advocate, and being suspected of entertaining opinions by no means favourable to the pretensions of that ambitious state, in respect to the Adriatic Sea, he had, besides, the imprudence to associate too much with the ambassadors of France and Spain. This was sufficient to awaken the jealousy of the most suspicious of all governments. His Lettera intorno al Dominio del Mare Adriatico ed ai Trattati seguiti in Venezia tra'l Papa Alessandro III., e l'Imperador Federico Barbarossa, published a short time before, in favour of the dominion of Venice over the Adriatic, could not remove the suspicions of the senate, and one night (in September, 1735), the *sbirri* of the republic seized him, and the poor author was transported, as a dangerous enemy of the state, beyond the frontiers of the Venetian territory, into the territory of Ferrara. Apprehensive of new persecutions, he took the name of Antonio Rinaldo, and after a short residence in Modena, Milan, and Turin, he retired with his son to Geneva, where he was not only received with respect by the most distinguished men, but also encouraged by the most liberal support. He was preparing to publish a supplement to his history of Naples, when, enticed by a villain, he had the imprudence to attend the Easter festival of 1736, in a village of Savoy, where he was immediately arrested and carried to the castle of Miolan, and afterwards to the fortress of Ceva, and finally into the citadel of Turin. Here he died at the age of seventy-two years, a victim of priestly hatred, after twenty-two years of confinement, which was during part of the time so strict that he was denied even the sight of his son. His manuscripts were carried to Rome by the order of the Papal court. His attempt to regain his freedom during the dispute between the courts of Turin and Rome, by writing in favour of the King of Sardinia, had been as unsuccessful as his recantation of the principles expressed in his Storia Civile, to which he was persuaded by the treacherous suggestions of Father Prever. His Opere postume in Difesa della sua Storia Civile appeared after his death, at Lausanne, 1760. The severest passages of the Storia Civile against the Roman Catholic clergy were published separately at the Hague in 1738. An English trans-

lation of this work, by Captain J. Ogilvie, appeared at London in 1729–31. The most recent edition of the original text appeared at Milan in 1823. In 1859 Mancini published an edition of his Opere Inedite, or works which had remained unpublished till that time.

GIANT BEDS (in German, *Hünengräber*) are tumuli in Germany, the graves of the ancient inhabitants of the country. They are of different sizes, and sometimes very large, generally inclosed with stones of such weight as would seem to have required machinery to move them. Earthen vessels, metallic ornaments, sacrificial stones, knives, battle-axes, &c., are sometimes found in them; and sometimes also human skeletons in the last stage of decay; sometimes they are entirely empty. They are found chiefly in woods and in high places, having probably disappeared from other parts in consequence of the advance of agriculture, bringing the low-lying tracts under cultivation.

GIANTS, people of extraordinary stature. History, both sacred and profane, makes mention of giants. Nothing is more natural, in ages when the past and the future are connected together only by tradition, than that the height of a tall man should be exaggerated every year after his death. In the same way a small person would dwindle into a dwarf or a pigmy. The same effect which is produced by distance of time is also produced by distance of place, so that a nation of tall men, living on a distant shore, would become, in the tale of the mariner, a race of giants. Nations and individuals in their childhood love the miraculous; and any event which deviates from the common course of things immediately becomes a wonder, on which poetry eagerly seizes; hence the Cyclopes and Læstrygones of the ancients, and the Ogres of romance. Instances, however, are by no means wanting of uncommonly large persons, hardly needing the exaggeration of a lively imagination to make them objects of wonder. The first mention of giants in the Bible is in Gen. vi. 4, where the Hebrew word used is *nephilim*, a word which occurs in only one other passage, where it is applied to the sons of Anak, who dwelt about Hebron, and who were described by the terrified spies as of such size that compared with them they appeared in their own sight as grasshoppers. A race of giants called the Rephaim is frequently mentioned in the Bible. In Gen. xiv. 5, and xv. 20, they appear as a distinct tribe, holding possessions in Canaan. At the period of the conquest of Canaan, Og, king of Bashan, who had a bedstead 9 cubits long, is said to have remained alone of this tribe, but this must be taken to mean alone on the east side of Jordan; for giants, who were probably of the same stock, are subsequently mentioned as living about Mount Ephraim (Jos. xvii. 15) and among the Philistines (2 Sam. xxi. 18). Goliath, who measured 6 cubits and a span, and who was slain by David, is the most celebrated of the giants mentioned as living among the Philistines. The other races of giants who are mentioned in the Bible (besides the sons of Anak already referred to) are the Emim, who occupied the country afterwards held by the Moabites, and the Zuzim (a branch of the Rephaim), who lived on the east side of the Jordan, between the Arnon and the Jabbok. In Deut. ii. 20 they are said to have been called by the Ammonites, who conquered them, Zamzummim.

The giants of Greek mythology are believed by some to represent the struggle of the elements of nature against the gods, that is, against the order of creation. They were said to have sprung from the blood of Uranus, which fell into the lap of Gē (the earth). Their mother, indignant at the banishment of the Titans into Tartarus, excited them to revolt against the gods. They hurled mountains and forests against Olympus, disdaining the lightnings of Zeus. An oracle having declared that the gods could not conquer except by the assistance of a mortal Athēnē called Heraclēs to their aid. He slew Alcyoneus and Porphyrion, the most formidable of the giants. Apollo and Heraclēs shot out the eyes of Ephialtes; Dionysus slew Eurytus with his Thyrsus; Hecatē and Hephæstus killed Clytius with clubs of hot iron; Poseidōn hurled a part of the island of Cos on Polybotes; Athēnē buried Enceladus under the island of Sicily, and flayed Pallas, and made a shield of his skin. The remainder perished under the hands of other deities by the thunderbolts of Jupiter or the arrows of Heraclēs. This fable perhaps indicates volcanic eruptions, for which the Phlegræan fields, where the chief scene of this struggle is placed, and where the two principal giants were born, were remarkable. Cos and Sicily, which figure in this fable, are also volcanic. Ovid has described the war of the giants in the beginning of his Metamorphoses.

Giants figure pretty largely in Celtic and Scandinavian mythology and legends. In the legends of the Irish there are the two giants, Fingall or Finn MacCumhal and his son Ossian. The giants of the Welsh are familiar to every one through the achievements of Jack the Giantkiller, the representative of the Scandinavian Thor, the destroyer of Skrimmer, and the Swiss giants.

Strabo tells of the skeleton of Antæus, found in Mauritania, 60 cubits long. Pliny speaks of a skeleton 46 cubits long, laid bare by an earthquake in Crete. In the battle between Marius and the Teutones, at Aquæ Sextiæ, the king of the latter, Theutobochus, is represented as a giant. In 1613 his skeleton was pretended to have been found in Upper Burgundy. A brick tomb was discovered 30 feet long, 12 feet broad, and 8 feet high, on which was the inscription *Theutobochus rex.* According to tradition a skeleton was in the grave, 25½ feet long, 10 across the shoulders, and 5 feet through, from the breast-bone to the back-bone. The thigh-bones were 4 feet long. The bones, the story says, were finally carried to England, and it is not known what became of them. We have similar accounts in the sixteenth century. Thus Dalechamp pretended to have found a skeleton 18 feet in length; Felix Plater, one of 19 feet, near Lucerne; and Licetus, one in Sicily, 30 feet in length. But it has long been known that these bones do not belong to giants, but to animals of the primitive world, which, from ignorance of anatomy, were taken for human bones. The Guanches, the original inhabitants of the Canaries, were described by a credulous traveller as appearing to have been at least 15 feet long, from an examination of their mummies. Similar accounts were given of the Patagonians; but Capt. Carteret, who measured several of them, found that most of them were but from 6 feet to 6 feet 5 inches high. The measurements of Wallis and subsequent voyagers agree with this. The ordinary height of men is between 5 and 6 feet, and the greatest deviations from this medium height in Europe are found in England, the United States, and Switzerland. Frederick William I. of Prussia had such a rage for collecting tall men as guards, that a man of extraordinary height could not escape being made a soldier, whatever was his profession. There were none below 7 feet in height. From the supplement to the English Cyclopædia (Arts and Sciences) we take the following authentic instances, ancient and modern, of persons who attained to the stature of giants. In the time of Augustus there were to be seen in the Horti Sallustiani at Rome, the bodies of a giant, Posio, and a giantess, Secundilla, each 10 feet 3 inches high. In

the reign of Claudius, an Arabian giant named Gabbaras, 9 feet 4 inches high, was exhibited at Rome. The Emperor Maximin, a Thracian, was nearly 9 feet high. A Jewish giant, about 10 feet high, is mentioned by Josephus. Long Mores, an Irish giant, of the time of Edward III., was 6 feet 10½ inches high. Queen Elizabeth's Flemish porter was 7 feet 6 inches; and J. Middleton, or the Child of Hale, born in 1578, attained the height of 9 feet 3 inches. C. Munster, a yeoman of the guard in Hanover, who died in 1676, was 8 feet 6 inches high; and Cajanus, a Swedish giant, about 9 feet high, exhibited in London in 1742. C. Byrne, who died in 1783, attained the height of 8 feet 4 inches; and Patrick Cotter O'Brien, a native of Kinsale, who lived about the same time, was 8 feet 7¾ inches. In 1884 died Pauline Wedde (called Marian), a German giantess, over 8 feet 2 inches at the age of eighteen; and in 1887 Josef Winkelmaier, an Austrian, 8 feet 9 inches, aged twenty-two. The following are still, or were recently, exhibiting: Anna Swan, a native of Nova Scotia, above 8 feet high; her husband, Captain Bates, a native of Kentucky, of the same height; Chang-wu-gon, the Chinese giant, 7 feet 9 inches high.

GIANT'S CAUSEWAY, an extensive and extraordinary assemblage of polygonal basaltic columns, on the north coast of Ireland, in the county of Antrim, between Bengore Head and Port Rush. It is divided into three unequal parts—the eastern, middle, and western causeway; the whole comprising a multitude of columns, consisting of prisms of equal dimensions throughout their whole height, which ranges from 15 to 36 feet, with a diameter of 15 to 28 inches, and varying in their number of sides from three to nine, although the greater number are pentagons and hexagons. Each of the pillars is perfectly distinct, and almost invariably differs in size, number of sides, and points of articulation from the adjacent columns; to which, however, it is so close that water cannot pass between them. Almost every column is composed of several pieces, the joints of which are articulated with the greatest exactness and in a strictly horizontal direction. Generally the upper part of the section is concave and the lower convex, but this arrangement is sometimes reversed. The basalt of which they are composed is of a very dark colour, approaching to black.

GIAOUR, a Turkish word, meaning infidel, used by Turks to designate the adherents of all religions except the Mohammedan, more particularly Christians. The use of it is so common that it is often applied without intending an insult.

GIBBET, a gallows, or a structure in form of a gallows, in which notorious malefactors were formerly hung in chains.

GIBBON (*Hylobates*). The apes known as gibbons, and belonging to the genus *Hylobates*, are nearer to the Cynomorpha or dog-faced apes than to the orangs, chimpanzes, or gorillas. They have ischial tuberosities: only the nails of the thumb and great toe are flat, the rest being narrow and pointed. The limbs are very long, the tips of the fingers touching the ground when the animal stands upright, and this length is of great use, since the animal balances itself by the fingers when running along the ground, which it does with great swiftness. But though thus able to move on flat ground, they are properly arboreal, travelling through forests with great rapidity. They average about 3 feet in height. One species, *H. syndactylus*, the siamang, has the second and third digits of the hind limb partly united, and the hair of the upper arm pointing downwards, of the forearm upwards. It is a native of Sumatra. The other species have the digits mostly free; they are natives of Cambogia, the Malay Peninsula, Sumatra, and Java. The relations of this genus to the other apes and to man will be summed up under GORILLA, which see.

GIBBON, EDWARD, an eminent English historian, was born at Putney in Surrey, April 27, 1737. He was the son of Edward Gibbon, a gentleman of an ancient Kentish family. After being two years at a private school at Kingston-upon-Thames, he was sent, at the age of twelve, to Westminster, where his weak state of health precluded him from making a regular progress in the classical studies of the school. After several changes of situation, in which he was chiefly the object of medical care, his constitution suddenly acquired firmness, and he entered as a gentleman commoner at Magdalen College, Oxford, before he had completed his fifteenth year. He remained fourteen months at Oxford, which he characterizes in his memoirs as most unprofitably spent, and his censure of that university is very strong and unequivocal. To a total neglect of religious instruction he attributes his boyish conversion to the Roman Catholic religion, which was produced by an assiduous perusal of the controversies between the Catholics and Protestants; and to use his own expressions, as he entered into the field 'without armour,' he fell before the 'weapons of authority, which the Catholics know so well how to wield.' Following his convictions, he in 1753 abjured the errors of heresy at the feet of a Catholic priest in London, and then wrote a long letter to his father to justify the step which he had taken. The consequence of this disclosure was his immediate banishment to Lausanne, where he was placed under the care of M. Pavillard, a learned Calvinistic minister, by whose efforts he was induced to return to the Protestant faith. His residence at Lausanne was highly favourable to his progress in knowledge and the formation of regular habits of study. The belles-lettres and the history of the human mind chiefly occupied his attention. In 1758 he returned to England, and immediately began to lay the foundation of a copious library; and soon after composed his Essai sur l'Étude de la Littérature in the French language, which for some years had been more familiar to him than his own. This work, which was printed in 1761, was a highly respectable juvenile performance, and obtained considerable praise in the foreign journals. He some time after accepted a captain's commission in the Hants Militia, and for some time studied military tactics with great assiduity; but he heartily rejoiced when the peace of 1763 set him free. After passing some months in the metropolis he then visited Paris and Lausanne, at which latter place he employed himself in collecting and preparing materials for a profitable journey to Italy. This took place in 1764; and it was at Rome, as he himself informs us, on the 15th of October in that year, as he sat musing among the ruins of the capitol, 'while the barefooted friars were singing vespers in the Temple of Jupiter,' that his idea of writing the Decline and Fall of the Roman Empire entered his mind. He had previously thought of the history of the Republic of Florence, and of that of the Swiss liberty, in the last of which he had made some progress, but he subsequently committed the MS. to the flames. In 1770 he first tried his powers in his native tongue by a pamphlet in refutation of Warburton's extraordinary hypothesis concerning the connection of Virgil's fabled descent of Æneas with the Eleusinian mysteries, entitled Critical Observations on the Sixth Book of the Æneid. It received great commendation, particularly from Professor Heyne, and proved a conclusive refutation. In 1774, by the favour of his kinsman Mr. (afterwards Lord) Eliott, he obtained a seat in Parliament for the borough of Liskeard, and was a silent supporter of the North administration and its American politics

for eight years. In 1776 the first quarto volume of his Decline and Fall of the Roman Empire was given to the public, and at once riveted general attention, the first edition going off in a few days, and a second and a third being scarcely equal to the demand. Of all the applause he received none seemed to flatter him so much as the spontaneous suffrages of Hume and Robertson. The prosecution of his history was for some time delayed by his complying with the request of ministers to answer a manifesto which the French court had issued against Great Britain preparatory to war. This he very ably executed in a Mémoire Justificatif, composed in French, which was delivered in a state paper to the courts of Europe; and for this service he received the appointment of one of the lords of trade (1778). In 1781 appeared the second and third volumes of his history. At a new election he lost his seat for Liskeard, but was brought in by ministerial influence for the borough of Lymington. On the retirement of the North administration he lost his appointment by the dissolution of the board of trade, and immediately formed the resolution of retiring to his favourite Lausanne, which plan he put into execution in 1783. Here, in the course of four years, he completed the three remaining volumes of his history, which were published together in April, 1788, on the fifty-first anniversary of the author's birth-day. The storms of the French revolution, which he regarded from the first with fear and aversion, gradually lessened his attachment to Lausanne, and in 1793 he returned to England. He spent some months with his friend Lord Sheffield, when a rupture, which he had endured for three-and-twenty years, terminated in a mortification that carried him off on the 16th January, 1794. In 1796 his friend Lord Sheffield published two quarto volumes of his miscellaneous works, of which the most valuable part is the Memoirs, which are written with much apparent frankness. Gibbon as a historian has gained enduring fame, and up to the present day the universal acknowledgment of the learned world has allowed him the highest rank. The merits and defects of his great history, its elegance and research, as well as its occasional indecency of allusion and its sneers at revealed religion, are too well known to need comment. Niebuhr, recognizing the excellence of Gibbon's work, professedly wished only to bring down his history to the period at which the former commences. A good edition of the Decline and Fall is that edited by Milman (London, 1838–39), with the notes of Guizot. An improved edition of this is that of Sir W. Smith in eight vols. (1854–55). An excellent new annotated edition is that of Prof. Bury (seven vols., 1896 onwards). In 1897 a selection of Gibbon's private letters was published in two vols., also Autobiographies in one. See also J. C. Morrison's Gibbon in the English Men of Letters series.

GIBBONS, Orlando, English musical composer, was born at Cambridge in 1583, and died on June 5th, 1625. At the age of twenty-one he was appointed organist of the Chapel Royal, and in 1622 he received the degree of Doctor of Music from the University of Oxford, at the recommendation of his friend the learned antiquary Camden. He died at Canterbury, where he had gone to be present at the marriage of Charles I. with Henrietta of France. He was buried in the cathedral, where his wife caused a magnificent tomb to be erected to him. He is the author of a set of Madrigals (London, 1612), and other musical works. Among his most celebrated sacred pieces are the anthems Hosanna to the Son of David, Almighty and Everlasting God, and O Clap your Hands Together.

GIBEON, one of the ancient royal cities of the Canaanites, a 'great city' of the Hivites, who at an early stage of Joshua's conquests entered into a stratagem to get terms of peace for themselves. Taking old clothes on their persons, and dry and mouldy bread in their bags, they professed to have come from a far country, and proposed an alliance with the Israelites, which was accepted by Joshua before the stratagem was discovered. When the discovery was made, the covenant was strictly observed, but the Gibeonites were condemned to be 'hewers of wood and drawers of water unto all the congregation' (Jos. ix. 21). The town of Gibeon fell afterwards to the lot of Benjamin. It was made a Levitical city, and the Tabernacle was transferred there from Nob after the slaughter of the priests. The engagement between the men of Abner and David took place here. Gibeon has been identified with the modern El-Jîb. A large number of the Gibeonites, who had made a covenant with Joshua, were massacred by Saul, for which crime seven of Saul's sons were delivered up by David to the Gibeonites to be hanged (2 Sam. xxi. 1–9).

GIBRALTAR, a town and strongly-fortified rocky peninsula near the south extremity of Spain, and at the western entrance of the Mediterranean, belonging to Great Britain. This remarkable fortress, which lies opposite Ceuta in Africa (distance between Europa Point and Ceuta 14½ miles), and forms the key to the Mediterranean, is connected with the mainland of Spain by a low sandy isthmus, the peninsula having the Bay of Gibraltar (or of Algeciras) on the west, and the open sea of the Mediterranean on the east. The British territory has a length of 2¾ miles and a greatest breadth of ¾ of a mile, the greater part of it consisting of 'the rock', at the foot of which, on the north, is a race-course, cemetery, &c. The highest point of the rock is about 1400 feet above sea-level. Its north face is almost perpendicular, while its east side also presents tremendous precipices. On the south it is almost inaccessible, making approach from seaward impossible; the west side, again, although nearly as rugged and precipitous as the others, slopes towards the sea; and here the rock is secured by extensive and powerful batteries, and other works rendering it apparently impregnable. The body of the rock consists of a kind of dense limestone arranged in beds of 30, 40, and 50 feet in thickness. There are a number of remarkable caves in various parts of the rock, but all difficult of access. The animals found on the rock include rabbits, partridges, &c., and a small number of Barbary apes. When seen from a ship's deck, little appearance of vegetation presents itself on the rock, the whole having an exceedingly barren and forbidding aspect; but it is not in reality so bare as it seems, the indigenous plants being upwards of 400 in number, while trees flourish in many places, including oranges, figs, poplars, pines, &c., with the aloe, prickly-pear, and dwarf palm. There are also more fairly level and open spaces (parade-grounds, gardens, &c.) than might be supposed. The climate is temperate during the greater part of the year, and even in the summer months the excessive heat is allayed by a refreshing sea-breeze that sets in during the forenoon and continues till sunset. Most rain falls in winter.

Vast sums of money and an immense amount of labour have been spent in fortifying this celebrated stronghold. Numerous caverns and galleries, extending 2 to 3 miles in length, and of sufficient width for carriages, have been cut in the solid rock, forming safe and sheltered communications from one part of the garrison to another in cases of attack.

Along these galleries are port-holes opening towards the bay or towards the Spanish territory (between which and the British territory there is a strip known as 'the neutral ground'); while trees, shrubs, and flowers of various kinds have been planted at different points, both for ornament and utility. On the summit of the rock there are barracks, signal-stations, &c. Of late years the fortifications have been carefully strengthened at every vulnerable point, and guns of the newest construction have been mounted in them. Gibraltar has a naval dock-yard, and is a victualling and coaling station of the British navy. Great harbour-works have for some time been in course of construction (at a cost of some £4,000,000), including a large area of sea inclosed by massy walls, and graving-docks large enough to accommodate the largest battle-ships. The materials have been mostly brought from the east side of the rock by means of a tunnel specially constructed for this purpose.

The town of Gibraltar is situated on the west side of the peninsula, fronting the bay. It consists of two portions, the North Town and the South Town, the former being much the larger and separated from the South Town by the Alameda Gardens, parade-ground, &c. The principal buildings are the governor's house, the naval hospital, the civil hospital, the garrison library (45,000 vols.), the court-house, revenue offices, remains of an old Moorish castle, and the barracks. The water for the supply of the town and garrison is collected in tanks during the rainy season. Splendid reservoirs for water have recently been constructed by government. Gibraltar is a free port, and serves as a valuable entrepôt for the distribution of British manufactures to the neighbouring countries. Among the chief articles of trade are cottons, woollens, and other manufactured goods, tobacco, wool, grain, wine, fruit, coals, &c. The value of the imports from Britain in 1899 was £754,789, chiefly coal, cottons, metals, beer, and woollens. The annual revenue usually amounts to about £60,000, the expenditure being rather less. There is no public debt. The money unit is the Spanish peseta, equivalent to a franc. The administration is vested in the governor, who is also commander-in-chief of the troops; and the settlement is treated as a garrison town, the power of enacting laws being vested in the governor alone. All criminal cases are determined according to the laws of England. New-comers to Gibraltar are stringently looked after. Foreigners are permitted to remain during specified periods only, and on giving the required security. The population in 1901 amounted to 27,460, including a garrison of 5349 men. The permanent residents are of very various origin—Spanish, Portuguese, Maltese, &c.

The name is formed from the Arabic words *gebel al Tarik* (the height or rock of Tarik), since Tarik Ibn Zeiad, the general of the caliph Valid, at the time of the irruption of the Moors into Spain (A.D. 711, and following years), landed at the foot of this rock (known as the *Calpe* of antiquity and one of the *Pillars of Hercules*—Abyla in Africa being the other), where he founded a strong fortress. About the beginning of the fourteenth century it was taken from the Moors by Ferdinand, king of Castile, but in 1333 it was recovered by them, and was not finally acquired by the Spaniards till 1462, when it was taken in the reign of Henry IV. The Duke of Medina-Sidonia, who had assisted in gaining it for the Christians, took forcible possession of it for himself, and it remained in the keeping of his family till 1501, when the Spanish sovereign got it into his own hands. The third duke unsuccessfully tried to recover it in 1506, by which time the fortress had undergone altogether some half score of sieges. The pirates of Algiers subsequently made an attack upon it, but were forced to retire. The German engineer, Speckel of Strasburg, in the reign of the Emperor Charles V., substituted for the old Moorish fortifications, works in the European style. In the war of the Spanish Succession the Spaniards were obliged to surrender this fortress, August 4, 1704, to the British admiral Rooke, assisted by a body of troops under Prince George of Darmstadt. From October, 1704, to April, 1705, it was besieged by the Spaniards. It was secured to Britain by the Peace of Utrecht in 1713. Since this time nothing has been omitted by Britain to render this fortress, which forms a bulwark of her Mediterranean trade, absolutely impregnable. As the increasing value of the place rendered the possession of Gibraltar more desirable to Spain, the siege of it was commenced March 7, 1727, but raised upon the approach of Admiral Wager, with eleven ships of the line. Spain then offered £2,000,000 sterling for the delivery of the place, but in vain; and by a compact at Seville in 1729 Spain agreed to renounce all its claims upon it. Still the Spaniards omitted nothing to prevent all entrance into the fortress, and to cut it off from the mainland, by constantly strengthening the lines of St. Roch and Algeciras. But it was easy to supply the inhabitants and garrison by sea. In the war which broke out between Britain and Spain in 1779 the last attempt was made for the recovery of Gibraltar. It now underwent the famous four years' siege from 1779 till 1783, but was ably and successfully defended by General Eliott, afterwards Lord Heathfield. (See HEATHFIELD, LORD.) It was secured to Britain by the Peace of 1783. Since that time, in the various British and Spanish, and also French wars, Gibraltar has only been blockaded on the land side.

GIBRALTAR, STRAITS OF, the channel forming an entrance from the Atlantic into the Mediterranean. The narrowest part is a little to the west of Gibraltar, and is 9 miles across; the total length is about 36 miles. The ancients called this channel the *Straits of Hercules*. A strong and constant current flows into the Mediterranean from the Atlantic Ocean, in the middle of the Straits, while two feeble lateral currents issue from this sea. A lower current is also found to prevail, setting out into the ocean.

GIBSON, JOHN, one of the most distinguished sculptors of modern times, born at Gyffin, near Conway, in Wales, in 1790; died at Rome in 1866. He was the son of a landscape-gardener, who, when his son was nine years of age, removed to Liverpool, where the latter was apprenticed first to a cabinet-maker, and afterwards to a wood-carver. By a figure of Time modelled in wax which he exhibited at the age of eighteen, he attracted the attention of some of the most influential lovers of art at Liverpool, several of whom showed the warmest interest in him. The principal of his patrons was W. Roscoe, author of the Life of Lorenzo de' Medici, who placed at his disposal for study all the art treasures which he himself possessed, and who got up a subscription to enable Gibson to proceed to Rome. On his way to Rome he spent some time in London, where he was encouraged by the praises of Flaxman. He arrived at Rome in October, 1817, bearing letters of recommendation to Canova, who gave him a very cordial reception, invited him to attend his studio without fee, and promised him every aid in his power. When Gibson set up a studio of his own Canova continued to bestow upon him every species of encouragement, and procured for him the patronage of the Duke of Devonshire, whom he took to see a group—Mars and Cupid—that Gibson had mo-

delled. The Duke of Devonshire was so struck with its merits that he desired it to be executed for him in marble; and this commission was soon followed by others from various art patrons. On the death of Canova in 1822 Gibson continued to reside in Rome, and entered the studio of Thorwaldsen. By this time his fame had spread widely, and he was requested by King Louis of Bavaria to execute several groups in marble for him; and his works were eagerly sought after by the wealthy in his native country. In 1826 he was made an honorary member of the Pontifical Academy at Bologna; in 1829 a member of the Academy of St. Luke's at Rome; in 1833 an associate of the Royal Academy; and in 1836 a Royal Academician. Gibson continued to the end of his life to make Rome his chief place of residence, although he made occasional visits to England, and in the latter years of his life usually spent his summers in Switzerland. The subjects of most of Gibson's works are taken from classical mythology, but in spite of this he was no servile imitator of the antique, but, on the contrary, exhibited thorough originality in his treatment, and gave marked individuality and expression to the goddesses, nymphs, and heroines of antiquity that proceeded from his studio. In his portrait statues he adhered to the practice, now given up, of draping his figures in classical costume. He was the author of one remarkable innovation, at least in modern sculpture, that of colouring his figures, and though he believed to the last that the experiments of this nature which he made were successful he never succeeded in securing the approbation of other artists for the practice. Among his coloured statues are one of the Queen for Buckingham Palace, a statue of Venus which he exhibited at Rome in 1854, as well as other works. Most of Gibson's chief works are in England, but they are nearly all the property of private collectors. One of his groups, Hylas and the Nymphs, is in the National Gallery, and by his will he bequeathed to the Royal Academy all his works in marble not sold at the time of his death, and all the models of his other works. There are casts of a number of his finest groups in the Crystal Palace.

GICZIN, a town in Bohemia, in the circle of Biczov, in a plain among mountains, on the Cydlina, 48 miles E.N.E. of Prague. It consists of the town proper, surrounded by walls, with three gates, and of four suburbs; is the seat of a civil and criminal court, and of several public offices; and has some general trade, and a trade in corn and cattle, a weekly market, and four large annual fairs. Pop. including suburbs, in 1900, 9790.

GIDEON (Hebrew, meaning a destroyer), the son of Joash, of the tribe of Manasseh, divinely called to deliver the Israelites from the oppression of the Midianites. Having effected their deliverance he was chosen judge of Israel. See Judges vi.–viii.

GIESECKÉ, Sir Charles. His father, whose name was Metzlar, was a tailor in Augsburg, and here his son was born in 1761. Young Metzlar studied for a time at Göttingen, then at Vienna, became dramatic writer and actor, assumed the name Giesecké, studied mineralogy under Werner in 1801, went to Copenhagen, and thence departed on a mineralogical expedition to Greenland, where he succeeded in discovering new minerals, and by a curious chance the locality of cryolite (which see). During his absence his books and minerals were destroyed in the bombardment of Copenhagen. After residing seven years in the country, he sent a cargo of minerals to Denmark, but the ship having been captured and brought to Leith, the minerals were sold. Three years later Giesecké returned to Europe, and he spent some time in examining the geology of Scotland. About 1813 he went to Dublin, where he was appointed professor of mineralogy to the academy, and received the honour of knighthood from the King of Denmark. He died at Dublin, March 5, 1833. He wrote on the mineralogy of Greenland, on cryolite, on the geology of parts of Ireland, &c. The unimportant mineral *gieseckite* was discovered by and named after him.

GIESSEN, a town of Germany, the capital of the province of Upper Hesse in the grand-duchy of Hesse, in the beautiful and fertile plain on the left bank of the Lahn, 40 miles north of Frankfort-on-the-Main. Some of the older streets are still narrow and irregular. The fortifications were levelled in 1803–11, and fine new quarters of the city have arisen outside of them. Its university was founded in 1607 by the Landgrave Ludwig V., and is now attended by about 1000 students. In connection with it there are a valuable library, an academic hospital, a chemical laboratory founded by Liebig, a botanical garden, a hygienic institute and museums. Among the other buildings and institutions of the town are: two Protestant churches and a Roman Catholic one; a new synagogue; the old castle, now an official building; the old town-hall; the arsenal, now a barracks; a new gymnasium and a real-school; and a court-house. The manufacture of tobacco and cigars is the leading industry, but the manufactures also include iron, machinery, cottons, beer, chemicals, and musical instruments. Pop. in 1895, 22,702; in 1900, 25,491.

GIFFORD, William, a celebrated critic and satirist, and the first editor of the Quarterly Review. He was born at Ashburton, in Devonshire, in April, 1757. His father, a plumber and glazier, having dissipated his property by extravagance and intemperance, died when the son was about twelve years old; and William fell under the guardianship of a person who sent him to sea with the master of a coasting vessel, but in a few months removed him from that situation, and apprenticed him to a shoemaker at Ashburton. Disgusted with this occupation and possessing a strong taste for study, he was fortunate enough to attract the notice of Mr. Cookesley, a surgeon of the town in which he resided, who raised a subscription to purchase his freedom for the latter part of the term of his indentures, and to pay for his education. After having passed two years at school he was, through the exertions of the same friend, supplied with the means of continuing his studies at Oxford, where he also obtained the office of Bible reader at Exeter College. While at the university he undertook a poetical translation of the Satires of Juvenal, but the death of his patron, Mr. Cookesley, interrupted the progress of the work; and at length, through a fortunate accident, he was introduced to Earl Grosvenor, and quitted Oxford to reside in the family of that nobleman. He afterwards travelled on the Continent with Lord Belgrave for some years, and on his return to England settled in the metropolis, devoting his time to literary pursuits. In 1794 he published The Baviad, a poetical satire, in which the poetasters of the Della Crusca school are the chief objects of his ridicule; and in 1795 appeared The Mæviad, a severe animadversion on the degraded state of the drama. These works, though virulent and coarse, display much critical ability. In 1797 he became editor of the Anti-Jacobin newspaper—an office which involved him in a quarrel with Dr. Wolcot, against whom he published a pamphlet in verse, entitled An Epistle to Peter Pindar. His translation of the Satires of Juvenal was published in 1802, and is executed in a manner highly creditable to his abilities. His next publication was an edition of the plays of Massinger,

with notes, and a life of that dramatist (1805); and he afterwards edited in a similar manner the works of Ben Jonson, Ford, and Shirley. He also translated the Satires of Persius. In 1809 he entered on the editorship of the Quarterly Review, of which he continued to be conductor till 1824, when he resigned. His death took place December 31, 1826, and he was interred in Westminster Abbey.

GIFT, in English law, a voluntary conveyance, without binding consideration, and therefore void in certain cases. In Scotch law the term is particularly applied to royal gifts, such as gifts of non-entry, escheat, &c.

GIJON, a seaport of Spain, in the province of Oviedo (Asturias), on the Bay of Biscay, 19 miles N.N.E. of Oviedo. It consists of an old and a new town, the former on the upper part of a slope, and partly walled, and the latter below, reaching down to the shore. The most important industrial establishment is a tobacco manufactory, but glass-making, the manufacture of pottery, &c., are also among its industries. It imports cereals, machinery, &c., and exports minerals, coal, &c. Pop. (1900), 47,544.

GILBERT, Sir Humphrey, an English navigator in the reign of Queen Elizabeth, was born in Devonshire about 1539, and studied at Eton and Oxford. Adopting the military profession, he served with reputation in France and Ireland. He was knighted in 1570, and returned to the House of Commons as member for Plymouth in the following year. In 1572 he led an expedition to Holland to assist the Netherlanders against Spain, but he was soon compelled to return. Possessing a strong propensity for speculation and enterprise, he turned his attention to maritime exploration, and published A Discourse of a Discovery for a New Passage to Cataia (1576; reprinted in Hakluyt's collection of voyages, vol. iii.). In 1578 Sir Humphrey Gilbert obtained from the queen a patent, empowering him to discover and colonize in North America any land then unsettled. His first voyage ended in complete failure, but in 1583 he sailed again with a small fleet, and, having landed on Newfoundland, he took possession of the harbour of St. John's. On his return voyage to England in a small sloop he was lost in a storm in the same year (1583).

GILBERTINE ORDER, an order of Augustinian canons founded in England by Gilbert of Sempringham about the middle of the twelfth century. They had numerous monasteries in England at the time of the general suppression of such establishments. There was also an order of nuns founded by the same person.

GILBERT ISLANDS, or Kingsmill Group, a group of fifteen islands in the Pacific Ocean, between lat. 1° 0′ S. and 2° 30′ N.; and lon. 172° 0′ and 174° 30′ E. They are the most easterly of the groups collectively constituting Micronesia, and are of coral formation, all low, the highest land in the group not exceeding 20 feet. Some of them seem to be undergoing a process of elevation. Their soil, which is but a few inches in depth, is of coral sand and vegetable mould. Their cultivation consists, for the most part, in that of the cocoa-nut and screw-pine, which are the chief vegetable articles of food. A species of the taro (*Arum cordifolium*) is also cultivated. The bread-fruit tree is found on the northern islands. Fish and turtles are caught in large numbers. The natives differ in their personal traits from the Polynesians, and more nearly resemble the Malays. The women are much smaller in proportion than the men, with delicate features and slight figures. The men are capital sailors, visiting distant islands in canoes of large size. The people have been partially Christianized, the southern islands being under the London Missionary Society and some of the others under American missionaries. The whole group is under the protection of Britain, but the islands are self-governed, a sort of republicanism prevailing. The total pop. is estimated to amount to 40,000.

GILBOA, Mt., a range of hills in Palestine, between the plain of Esdraëlon and the Jordan valley, giving rise to some of the sources of the river Kishon, and now known as Jebel Faku; height, 1696 feet. At the northern base of the hill which is identified with the ancient Gilboa there is a large spring called Ain Julûd, which is supposed to be the fountain of Jezreel, beside which Saul pitched his camp before the memorable battle in which he fell (1 Sam. xxix. 1).

GILD, a corporation. See Guild.

GILDAS, an early British historian, was born probably in 516, though some authorities assign an earlier date. He was an ecclesiastic, and seems to have died about 570, but of the facts of his life almost nothing is known. From him we have a work, called in the oldest Latin manuscript Liber querulus de Excidio Britanniæ, which is the only contemporary account of any portion of the English conquest of Britain. Its style is extremely verbose and obscure, and it is rather a lament over the success of the Saxons and the shortcomings of the Britons than a narrative of events. It was written in his forty-fourth year, probably in Brittany. It has long been divided, though somewhat arbitrarily, into a Historia Gildæ and an Epistola Gildæ. In 1525 the first printed edition was issued at London, and among the best of the later editions are that of Stevenson (English Historical Society, 1838) and the one contained in the Monumenta Historica Britannica (1848). The earliest English translation is that of J. Habington (1638), and one of the most recent is that contained in Bohn's Six Old English Chronicles. Two old lives of Gildas are extant. One is by a monk of the monastery of St. Gildas, said to have been founded by him at Ruys, and the other is ascribed to Caradog of Llancarvan; but both are untrustworthy. The difficulties presented by the few facts recorded of Gildas's life have led some to assume that there were more than one person of the name.

GILDING is the art of applying and permanently attaching gold-leaf or gold-dust to surfaces of wood, stone, metals, &c. The Egyptian monuments present numerous traces of the existence of the art in ancient Egypt. The process seems to have been nearly the same with that now used. The Persians were also acquainted with this art, as appears from the ruins of Persepolis. The Greeks and Romans employed gilding for many purposes. The Greeks used to gild the hoofs and horns of victims. The practice of gilding statues prevailed in the infancy of the art of sculpture, and was never entirely dropped by the ancients. The Romans used to gild sweetmeats; and many articles of furniture and utensils which have come down to us are gilt. There are also specimens of gilt glass and metals. The gilding which still remains on some ancient bronze monuments is remarkable for its brilliancy. This is owing, in part, to the great accuracy of the finish, but in part to the thickness of the leaf, which was much greater than that of the leaf used by the moderns. Besides, we must consider, that, in the most common way of gilding brass with an amalgam of gold and quicksilver, the gold is reduced to a state of much greater subdivision than in the leaf—the only state in which the ancients employed it. The account of Pliny shows that they did not fix the leaf merely by the aid of fire, as is now done in gilding metals, but that they

first covered the substance with quicksilver, which was then evaporated by heat, in a manner somewhat similar to the modern practice of gilding with amalgam. The ancients carried the practice of gilding to a greater extent than the moderns: they gilded almost all their statues of bronze, wood, or plaster, and frequently those of marble, the ceilings of rooms, and even marble columns, eatables, and victims. The *bracteatores*, or *inauratores*, were in high esteem among them, and enjoyed an exemption from taxes. In architectural ornaments gilding may please the eye, either from its appearance of richness, or merely from its agreeable colour. The most remarkable examples of gilding, employed with taste and effect in architecture, are the ceiling of St. Peter's, and that of Santa Maria Maggiore. But artists often fall into the error of mistaking richness of appearance for beauty.

The art of gilding, at the present day, is performed either upon metals, or upon wood, plaster, leather, parchment, paper, glass, &c. Chemical processes are those which are usually employed for metals. Gilding on copper is performed by the process called *wash* or *water gilding*, with an amalgam of gold and mercury. The surface of the copper, being freed from oxide, is covered with the amalgam, and afterwards exposed to heat till the mercury is driven off, leaving a thin coat of gold. Copper, however, is rather too soft and dark-coloured a metal for being treated in this way with advantage. Brass is a very suitable metal for this mode of gilding, but the best of all is a mixture of copper with one-seventh of brass. The following method of gilding articles of copper, brass, &c., was patented by Mr. Elkington in 1836:—Five oz. troy of fine gold are dissolved by heat in a mixture of 21 oz. of pure nitric acid of specific gravity 1·45, 17 oz. of pure hydrochloric acid of specific gravity 1·15, and 14 oz. of distilled water. The liquid is then poured off into a stone vessel, the sediment being left at the bottom of the vessel in which it was first contained. Four gallons of distilled water and 20 lbs. of the best bicarbonate of potash are now added, and the whole is boiled moderately for two hours. At the end of this time the mixture is ready for use. The articles are gilded by being attached to wires and plunged into the mixture, where they are allowed to remain as long as the workman thinks necessary, from a few seconds to a minute when the mixture is newly prepared, but longer if it has been used for some time. Gilding is also performed by dipping a linen rag in a saturated solution of gold, and burning it to tinder. The black powder thus obtained is rubbed on the metal to be gilded, with a cork dipped in salt water, till the gilding appears. Iron or steel is gilded by applying gold-leaf to the metal, after the surface has been well cleaned, and heated until it has acquired the blue colour, which at a certain temperature it assumes. Several leaves of gold are thus applied in succession, and the last is burnished down cold. The same process may be applied to copper. The operation of gilding may also be performed on iron and steel by diluting the solution of gold in nitro-hydrochloric acid, with alcohol, and applying it to the clean surface. A saturated solution of gold in nitro-hydrochloric acid, being mixed with three times its weight of sulphuric ether, dissolves the chloride of gold, and the solution is separated from the acid beneath. To gild the steel it is merely necessary to dip it, the surface being previously well polished and cleaned, in the ethereal solution for an instant, and, on withdrawing it, to wash it instantly by agitation in water.

Gilding on wood, plaster, leather, parchment, or paper, is performed by different processes of mechanical gilding. The first of these is oil-gilding, in which gold-leaf is cemented to the work by means of oil-size. In the case of paper or vellum the parts to be gilt receive a coat of gum-water or fine size, and the gold-leaf is applied before the parts are dry. They are afterwards burnished with agate. Lettering and other gilding on bound books are applied without size. The gold-leaf is laid on the leather and imprinted with hot brass types. Brass rollers with thin edges are employed in the same way for lines, and similar tools for other ornaments. When the edges of the leaves of books are to be gilt they are first cut smooth in the press, after which a solution of isinglass in spirits is laid on, and the gold-leaf is applied when the edges are in a proper state of dryness. Japanner's gilding is another kind of mechanical gilding, which is performed in the same way as oil-gilding, except that instead of gold-leaf a gold dust or powder is employed.

Porcelain and other kinds of earthenware, as well as glass, may be gilt by fixing a layer of gold in a powdered state by the action of fire. The gold-dust or powder required in this operation may be obtained by precipitating it from a solution in aqua regia, either by means of sulphate of iron or proto-nitrate of mercury. In order that the gold powder may be applied to the surface of the article to be gilt it must be well mixed with some viscous vehicle, such as spirits of turpentine mixed with some fatty matter, or strongly gummed water. It is then laid on with a fine camel's hair brush. When the article to be gilt is made of soft porcelain, delftware, or any kind of earthenware with a plumbiferous glazing, nothing else is required than to apply the gold in this manner, and then subject the piece of earthenware to a heat sufficient to soften the glazing, and thus fix the gilding. But in the case of hard porcelain, some kinds of stone-ware and other varieties of pottery, in which the glazing does not soften at a suitable temperature, the gold powder, before being mixed with the viscous vehicle by which it is applied, must have a flux added to it, which serves as the means of attachment between the metal and the earthenware. The best flux is oxide of bismuth precipitated by water from a solution in nitric acid, with the addition of one-twelfth part of melted borax. One-tenth or one-fifteenth part of this flux is added for every part of gold contained in the mixture, which is applied to the surface of the earthenware. Heat is applied in the same way as in the previous case to melt the flux, and thus fix the layer of gold to the article. The gilding must finally be burnished, in order to bring up the gold colour. Another method of gilding these substances is to mix neutral chloride of platinum with rectified spirits of turpentine in such a manner that the chloride is held in suspension in a finely divided state in the turpentine, to apply this liquid to the article to be gilt by means of a brush, and then to subject the article to heat so as to volatilize the spirits of turpentine and leave a uniform layer of platinum affixed to the glass or earthenware. The article, after being cooled, cleaned with aqua fortis, and washed with water, is next dipped in a gilding liquid prepared like that already described as patented by Mr. Elkington. The gilding is completed by rubbing the gilt parts with chamois leather. This method of gilding has the advantage of enabling the gilder to dispense with the burnishing, which is a very hazardous operation for fragile articles, and in the case of those which are of a very intricate form or very deeply cut out often impracticable. For a description of the processes of electro-gilding, see ELECTRO-METALLURGY.

GILEAD, THE MOUNTAINS OF, in ancient geography, part of the ridge which runs south from Mount Lebanon, on the east of Palestine. They

gave their name to the whole country which lies on the east of the Sea of Galilee, and included the mountainous region called in the New Testament *Trachonitis*. Gilead was noted for its excellent balm, as well as for its pasturage.

GILES, St. (*St. Ægidius*), a native of Greece, who, according to the legend, lived in the sixth century, and was descended from an illustrious family. He gave all his property to the poor, and went to France, where he worked miracles, and founded a convent. He is still revered in that country. A relic of this saint was carried to Scotland, and bequeathed, under James II., to the church of Edinburgh: hence he became the patron of that city. The 1st of September is the day dedicated to his honour.

GILES, St. (St. Giles in the Fields), a parish in London, a mile to the north-west of St. Paul's. The church, in High Street, is in classical style, and contains the remains of Chapman, Shirley, Marvell, Lord Herbert of Cherbury, and Sir Roger L'Estrange. One district of it, by its poverty and wretchedness, long formed a very striking contrast to the west end of the metropolis, so that St. Giles and St. James were spoken of as typical of wretchedness and luxury respectively. There is another church of St. Giles, called St. Giles Cripplegate, which contains the tomb of Milton.

GILFILLAN, Rev. George, a well-known Scottish clergyman and *littérateur*, was born on Jan. 30, 1813, at Comrie, Perthshire, where his father had laboured long as a Secession minister. Gilfillan studied at Glasgow University, and in 1836 he was ordained to the School Wynd Church in Dundee, an office which he retained till his death, which occurred suddenly at Brechin, August 13, 1878. He was constantly before the public as a lecturer, critic, or editor. His best-known works are the Gallery of Literary Portraits (1845–54); The Bards of the Bible (1851); Martyrs and Heroes of the Scottish Covenant (1852); History of a Man (1856), partly autobiographical; Night, a Poem, extending to nine books (1867); Remoter Stars in the Church Sky (1867); and a Life of Scott (1870). He was the editor of an extensive edition of the British Poets. His last work was a Life of Burns (1878–79). Gilfillan's faults as a writer are those of vehemence, and in general of excess; as a poet he made no mark.

GILFILLAN, Robert, a Scottish poet, was born in Dunfermline on 7th July, 1798, and was apprenticed to a cooper in Leith. On the expiration of his apprenticeship he returned to Dunfermline, and was employed in a grocer's shop. Afterwards he obtained a situation in Leith, and in 1837 he was appointed collector of police rates in Leith. His first publication was in the form of a small volume, entitled Original Songs, in 1831. Enlarged editions appeared in 1835 and 1839. He died on 4th December, 1850.

GILLIES, John, historian and scholar, was born at Brechin, in Forfarshire, on Jan. 18, 1747, and died at Clapham, near London, on Feb. 15, 1836. He was educated at the University of Glasgow, after which he became tutor to a son of the Earl of Hopetoun, and finally settled in London, where he applied himself to literature. In 1793 he was appointed historiographer-royal for Scotland. His first published work was The Orations of Lysias and Isocrates, translated from the Greek, &c. (1778). This was followed by The History of Ancient Greece—its Colonies and Conquests, from the earliest accounts till the Division of the Macedonian Empire in the East, including the History of Literature, Philosophy, and the Fine Arts (1786); described as a well-conceived work, but extremely verbose in its style. It was translated into both French (by Carra, 1787–88) and German (1825). A continuation of this work was afterwards published under the title of The History of the Ancient World, from the Dominion of Alexander to that of Augustus (1807–10). He also published a translation of Aristotle's Ethics and Politics (1797), with other works upon Aristotle, and a View of the Reign of Frederick II. of Prussia, with a parallel between that prince and Philip II. of Macedon. The translations of Gillies have the same defects of style as his historical works, and are, besides, condemned for their inaccuracies.

GILLRAY, James, English caricaturist, was born in 1757, and died in London on the 1st of June, 1815. Some clever sketches exhibiting a great amount of humour, published about 1785, first attracted the attention of the public to him. From this time till about 1810 he kept his position before the public by a succession of caricatures in which at first the king (George III.), his friends and ministers, and the members of the House of Lords, and afterwards the French, and the French celebrities of the day, were the chief objects of his ridicule. In the closing years of his life he was attacked by a mental malady which continued till the time of his death. In 1849 a complete edition of the engravings of Gillray which had appeared between 1799 and 1810 was published by Bohn. A descriptive volume of letterpress in connection with this edition, by T. Wright and R. H. Evans, was published in 1850. An earlier edition of Gillray's caricatures, by Maclean, is now rare.

GILOLO, Djilolo, or Halmahera, an island in the Indian Archipelago, the largest of the Moluccas; separated on the west from Celebes by the Molucca Passage, from Papua and Waygiou on the east by the Gilolo Passage, and from Ceram and Booro on the south by Pitt Passage. With various small islands near its coasts it has an area of 6500 square miles. The island is of singular form, its shape resembling that of Celebes, the result, as in the case of Celebes, of violent volcanic action. It consists of four peninsulas, radiating N., N.E., E.S.E., and S., from a common centre, and having large bays between. Gilolo, like several other islands in these seas, rises abruptly from a sea of profound depth. A circumstance unfavourable to its productiveness is that a large portion of the rich soil created by the decomposition of the volcanic rock is washed away into the ocean. It contains many volcanoes, chiefly in the north, one of which, Gamakora, is 6500 feet high. The principal productions of the island are sago, cocoa-nuts, spices, fruits, edible birds' nests, a durable and beautiful wood well adapted for ship-building, pearls, mother-of-pearl, tortoise-shell, and gold-dust; horses, horned cattle, and sheep also abound. Deer, wild boars, and other descriptions of game are likewise plentiful. The original inhabitants of Gilolo, called Alfoories, are robust, temperate, and brave, but have been gradually pressed into the interior of the island by the Malays, who have established themselves along the coast. The latter are strongly disposed towards commerce, and have an irrepressible predilection for a seafaring life. Gilolo forms part of the Dutch residency of Ternate. Pop. about 125,000.

GILTHEAD (*Chrysophrys aurata*), a fish belonging to Cuvier's great order of Acanthopterygii, and to the Sparidæ or sea-bream family. It has round molar teeth on the sides of the jaw, forming three rows in the upper jaw, and a few conical teeth in front; a transverse yellow band stretches from the one eye to the other (whence its scientific name, literally signifying 'golden eyebrows'). It is described by Lacépède as shining with the mild lustre of silver and sky-blue, the latter colour, which is that

of its back, being more heightened by the silvery tints which are spread over the rest of its body, and both these colours rendered more conspicuous by the black of the dorsal and caudal fins, as well as by the longitudinal brown lines which pass along the sides. It is a fine fish, which lives in all waters, fresh or salt, flowing or standing. It sometimes reaches a weight of 18 to 20 lbs. The fish is well known in the Mediterranean, but is also found much farther south, and it appears from Pliny and Columella that it was held in much esteem for the tables of ancient Rome, for the supply of which it was kept in ponds, and fed with oysters to give it a better appearance and flavour. Shell-fish and crabs are said to be its chief or only food in its free condition, the solid structure of its teeth being well fitted to crush them in such a way as to be fit for digestion. Another species, *Chrysophrys microdon*, has smaller teeth and a fuller profile than the first.

GILT TOYS is the trade term applied to cheap trinkets made usually out of copper or German-silver, with a very thin coating of gold or silver on the surface. In this way articles are made at a lower price than gold and silver jewelry, which may, nevertheless, have all the brilliancy of the real jewelry, and may be as little liable to tarnish. This industry has been very greatly developed within recent years. In Great Britain it is almost exclusively carried on at Birmingham; and in France it is important in Paris and Lyons. There are three ways in which trinkets of this kind are generally made. Sometimes they are made out of thin leaves of metal, one of the surfaces of which is gold and the other German-silver. Another way of making these cheap trinkets is by means of gilt copper-wires, which the workman twists into a great variety of forms; and the third way is first to make the trinkets entirely of copper, and then to gild them (see GILDING).

GIMBALS, a contrivance, as a ring moving on horizontal pivots, for securing free motion in suspension, or for suspending anything, as a clinometer, so that it may keep a constant position or remain in equilibrium. The term is most commonly applied in the plural to two movable hoops or rings, the one moving within the other, and each perpendicularly to its plane, about two axes, at right angles to each other. This contrivance is used in the mariner's compass. The object of the gimbals is to maintain the compass-bowl and the compass-card horizontal in spite of the motions of the ship. Of the two concentric rings or circular straps of copper, the outer turns about a horizontal axis, the extremities of which are supported by the compass-box. The inner turns about a horizontal axis at right angles to that just mentioned, the extremities of which are supported in holes in the outer ring. The compass-bowl, that is, the copper bowl that supports the fine point on which the card rests, is attached to the inner ring, and is so weighted as to tend to remain horizontal. Thus the pivot on which the needle turns is kept always vertical, however much the ship may roll.

GIMLET, a tool used for boring holes in wood or other substances, and consisting of a cylindrical piece of steel with a conical screw-point at the end, and above that a groove (called a cup), either cut longitudinally up the stalk or (in the more improved form) twisted spirally round it, and with a transverse handle, into which the stalk is inserted by the end opposite to the screw-end. In boring, the screw-point makes a passage for the stalk, the edges of the groove cut out the wood, and the fragments so cut are contained in the groove and withdrawn from the hole along with the tool.

GIMP, a silk, woollen, or cotton twist made stiff by a fine metallic wire, or sometimes a coarse thread, running through it, and much used in trimmings for dresses, curtains, &c.

GIN, a spirit distilled from grain, and flavoured with juniper berries, angelica root, almond-cake, calamus root, cardamoms, cinnamon, coriander, orris root, or some other similar substance. The name is derived from *genièvre*, the French for 'juniper'. It is largely manufactured in Holland, particularly in Schiedam, and the gin imported into Great Britain from Holland is hence frequently called Schiedam as well as Hollands gin. In the distilleries of Schiedam, gin is made from two parts of unmalted Riga rye and one part of malted barley. On being taken from the fermenting tun, the wash or fermented wort which is obtained from these constituents receives 2 lbs. of juniper berries from three to five years old, along with ¼ lb. of salt, for every 100 gallons. The whole is then put into the still, and the spirit drawn off. In Great Britain, gin is largely manufactured in London, and to a less extent at Plymouth and Bristol. Gin is perhaps more frequently adulterated by the dealers than any other liquor, various spices being used to give it a greater pungency. *Old Tom* is a sort of sweetened gin, which was named from its original manufacturer, one Thomas Chamberlain.

GIN, COTTON. See COTTON.

GINGER (*Zingiber officinale*) is an East Indian plant, belonging to the natural order Zingiberaceæ. The underground stem or rhizome, erroneously called the root, is about the size of a finger, knotty, creeping, and produces three or four sterile stems with alternate lanceolate leaves, the flowering stems being separate from these, and covered with membranous scales, of which the upper and larger envelop the flowers. It grows in moist places in various parts of tropical Asia and the East Indies, and is cultivated in the West Indies, particularly in Jamaica. The rhizome has an aromatic, pungent taste, and is much used by the inhabitants as a condiment, and sometimes, when green and mixed with other herbs, as a salad. It is also candied, and makes an excellent preserve. It is used medicinally as a carminative, and in debility of the stomach and alimentary canal. The varieties recognized in commerce are Jamaica white ginger, Barbados ginger, African ginger, East India ginger, and Tellicherry ginger; also Jamaica black ginger and Malabar dark ginger. Ginger was known to the Romans during the time of the emperors, and is described in Pliny as being brought from Arabia.

The rhizome of *Zingiber officinale*, when young, is fleshy and aromatic; and in this state it is kept in syrup, and constitutes preserved ginger. As it grows older it becomes harder and woodier, and also more pungent and aromatic; and this form, when cleaned and dried in the sun, gives *white* ginger; but if it be steeped in hot water and scraped, *black* ginger is produced. It consists mainly of woody fibre, starch, mucilage, gum, resin, matter insoluble in alcohol, matter insoluble in potash, and a small quantity, 1·5 per cent, of volatile oil. This last is yellowish, very fluid, has an aromatic taste and odour, is lighter than water, and boils about 470° Fah. Ginger enters into the composition of a great number of infusions, pills, syrups, powders, &c. The special preparations are the *tincture*, by exhausting the powdered rhizome with strong spirit; and a stronger preparation called the *essence* of ginger; *syrup*, prepared by mixing twenty-five parts of syrup with one of the strong tincture. The syrup is apt to become crystalline. *Infusion* of ginger is a readily-made preparation, useful for flatulence; the ginger

is digested with boiling water for a couple of hours, and a table-spoonful or two of the infusion is taken as required.

GINGER-ALE, an aërated water used as a beverage, made in the same way as lemonade, except that it is flavoured with ginger instead of lemon.

GINGER-BEER. The following is one of several recipes for the manufacture of this beverage:—Boil 1½ lb. of bruised Jamaica ginger in 3 gallons of water for half an hour; then add from 18 to 24 lbs. of good white sugar, 1 quart of lemon or lime juice (instead of which may be used, though not so well, 4 oz. of cream of tartar or tartaric acid), and 1 or 2 lbs. of the finest Narbonne honey, along with 15½ additional gallons of water. Next strain the mixture, and when the liquor has become almost cold add the white of an egg, and ½ fluid oz. of essence of lemon, then strongly agitate the vessel for about half an hour. Allow the whole to stand fermenting from three to six days, according to the state of the weather, then bottle. A kind of ginger-beer may be expeditiously made by pouring a gallon of boiling water over ¾ lb. of loaf-sugar, 1½ oz. of sliced ginger, and the peel of one lemon, and after allowing the mixture to cool till it is milk-warm adding the juice of a lemon and a spoonful of yeast.—Ginger-beer powders may be made of the following constituents:—5 oz. white sugar, 1½ oz. tartaric acid, 1½ oz. carbonate of soda, 2 drachms powdered Jamaica ginger, and ten drops of essence of lemon. If all the materials are mixed together in the process of manufacture, then it is necessary to see that they are carefully dried before mixing, mixed, while still warm, in a warm mortar, and immediately bottled. If the acid and the carbonate of soda are kept separate, it is unnecessary to take these precautions.

GINGER-BREAD, a well-known kind of cake, made in a variety of ways. One of the best ways is to boil ¾ lb. of treacle, ½ lb. of sugar, and 6 oz. butter together for five minutes; pour the mixture, when boiling, on 12 oz. flour, add a teaspoonful of ginger and allspice in powder, with the peel of a lemon grated, and when cold bake the preparation in tins.

GINGER-CORDIAL, or GINGER-WINE, as a liqueur, may be made by steeping 1 lb. of raisins, the rind of a lemon, and ¾ oz. of bruised ginger in a quart of the best whisky or brandy, straining, and adding 1 lb. of powdered loaf-sugar to every quart of juice.

GINGHAM, a kind of cotton, the manufacture of which was introduced into Great Britain (with the name) from India. It is distinguished from calico by having the colours woven in with the fabric, not printed on it. The patterns are various; sometimes fancy designs, sometimes chequered, and sometimes striped. Umbrella ginghams are all of one colour.

GINGKO, the Japanese name of a genus of trees called by Smith *Salisburia*, belonging to the natural order Coniferæ, and the sub-order Taxineæ (the yew family). This genus is characterized by dicecious flowers; catkins with male flowers; stamens with short filaments inserted near the axis; anthers with two pendulous cells and longitudinal dehiscence; female flowers, solitary or in fascicles, with a sessile disk at the base of the ovule, perforated at the top; seeds, with two linear cotyledons in a fleshy endosperm. The *Salisburia adiantifolia* of Smith (*Gingko biloba*, Linn.) is a tree which sometimes attains a height of nearly 100 feet. It does not contain any resin, like most of the Coniferæ. Its head is conical, and the branches are usually horizontal. The leaves are compound, with from two to four thick coriaceous leaflets marked with small longitudinal nervures. This fine tree is a native of China and Japan, and was first introduced into Europe in 1754, when it was brought to England. Its fruit, which is of the size of a small plum, has a pulp with a disagreeable odour of butyric acid, and inclosing a kernel which, when roasted, may be used as food, having a taste like that of maize. Many trees of this kind are now to be seen in England. It flourishes best in the shade, in a deep and somewhat moist soil. Its fruit was developed, for the first time in Europe, in the neighbourhood of Geneva in 1822.

GINGUENÉ, PIERRE LOUIS, a French critic and historian of literature, born at Rennes, in Brittany, in 1748; died at Paris, 1816. At Paris he was obliged to divide his time between labours in one of the *Bureaux du Contrôle Général* and his studies. During the revolution era he discussed the events of the day, with calmness and moderation, in the Feuille Villageoise. At this period he also began to contribute to the Moniteur, which he continued to do till his death. In 1793 he was thrown into prison as an adherent of the moderate party, but recovered his freedom after the fall of Robespierre. After the *coup d'état* of the 18th of Brumaire (Nov. 9, 1799) he became a member of the tribunate, but in 1802 he was excluded from this body on account of his independence and frequent opposition to the government. He was then appointed member of the committee tasked with continuing the literary history of France, and this office he held till his death. He is the author of Lettres sur les Confessions de J. J. Rousseau (Paris, 1791, translated into English, London, 1792), a work that, from the rigid impartiality with which he examined Rousseau's life, did more for his defence than would have been effected by the most laboured panegyric; Histoire Littéraire d'Italie (Paris, 1811, the last two volumes having been published posthumously), his most valuable work; Fables (Paris, 1810); &c. He also contributed a good deal to the Biographie Universelle.

GINSENG. The root of this plant has been celebrated for a long time among the Chinese, entering into the composition of almost every medicine used by the higher classes; and, indeed, so highly is it prized as to have received the appellations of 'pure spirit of the earth,' and 'plant that gives immortality.' Volumes have been written on its virtues, recourse is had to it in every difficulty, and it is said to be sold in China for its weight in gold. The plant, which is the *Panax schinseng* of botanists, belongs to the natural order Araliaceæ, and is herbaceous, about 1 foot high, upright, and furnished above with three petiolate leaves, from the centre of which leaves arises a peduncle, terminated by a small umbel of greenish inconspicuous flowers, which are succeeded by rounded and slightly compressed scarlet berries. It is said to be a native of Tartary, growing wild in a mountainous and wooded region between lat. 39° and 47°, where it is collected with many precautions by the Chinese and Tartars, at the commencement of spring and in the latter part of autumn. An early traveller relates that the Emperor of China employed, in one year, 10,000 Tartars in procuring this root. From China it is imported into Japan, where it was obtained by the Dutch, who first brought it to Europe. Notwithstanding the extravagant price and high reputation of ginseng in China, it appears to be really a plant of very little efficacy; the taste is sweet and mucilaginous, accompanied with some bitterness, and also slightly aromatic. The same plant, at least it is so considered by botanists, inhabits America, chiefly upon or in the vicinity of the Alleghany Mountains, and has been exported to China in such quantities as to reduce the price very much. Another species of ginseng, *Aralia quinquefolia*, Decaisne (*Panax* of Linn.), inhabits Canada and the north-eastern parts

of the United States. The composition of ginseng root does not seem to have been determined.

GIOBERTI, Vincenzo, an Italian philosopher and statesman, born at Turin in 1801; died at Paris October 26, 1852. Having been educated for the church, he was appointed, on the recommendation of his instructors, chaplain to Charles Albert, king of Sardinia, soon after the latter's accession, but having rendered himself obnoxious to the government by his republican sentiments, he was first imprisoned, and afterwards, in 1833, banished. The first few years of his exile he spent at Paris, and then went to Brussels, where he became teacher of philosophy in a private school. There he published his Teorica del Sovranaturale, and shortly afterwards his Introduzione all Studio della Filosofia, an attempt to reconcile philosophy and Roman Catholicism. The success of this work induced the Grand-duke of Tuscany in 1842 to offer the chair of moral philosophy in the University of Pisa to the author, but King Charles Albert's influence caused the offer to be withdrawn. The first work of Gioberti, which caused some commotion in the political world, was his Primato Morale e Civile degli Italiani, a defence of the Papacy, published in 1843, in which, although the Jesuits are treated with leniency, the author has mingled liberal ideas in politics with his religious sentiments. The effect of this book was to bring over the majority of the priests in Italy to the national party. Soon after, however, Gioberti, tired of passing as the friend of the Jesuits, published his Prolegomeni al Primato, in which he pronounces against the influence of that society, and two years later (1847) completed his rupture with that body by the publication of his work entitled Il Gesuita Moderno. When Charles Albert, in February, 1848, granted a constitution to Sardinia, Gioberti took advantage of the opportunity to return to his native country. There he enjoyed a well-merited influence, and became president of the chamber of deputies, and afterwards, in December, 1848, prime minister. In this position he endeavoured to secure the triumph of the idea of Italian nationality by the elevation of the house of Savoy, but early in 1849 he was obliged to resign his office, without being able to carry into effect the design he meditated. He then withdrew to Paris, where he passed in retirement the closing years of his life. In spite of the merits of Gioberti as a thinker and a writer, his works have only a passing interest, bearing too exclusively on the events of the time in which he lived.

GIOJA DEL COLLE, a town in Italy, in the province of Bari, in the district of Altamura, and 21 miles E. of the town of Altamura, on a slope on the east branch of the South Apennines. Pop. 14,000.

GIORDANO, Luca, a painter, born at Naples about 1632, a scholar of Spagnoletto, went to Rome to study the great Italian masters, and became the pupil of Peter of Cortona, whom he assisted in his great works. Paul Veronese had afterwards a great influence on his manner. He imitated the greatest masters so well that even connoisseurs were imposed upon. He acquired the name of *Luca fa presto* ('Luke, make haste'), on account of the incredible celerity of his execution, or more probably because his father, from avarice, often urged him, by this phrase, to expedition. He was rich in invention; his colouring was soft and harmonious, his pencil free and rapid, and he was well grounded in perspective. He was much employed at Naples after his return, especially in painting for the churches. In 1679 he was invited to Florence, and in 1692 to Madrid, where he was appointed painter to the king, and was employed by Charles II. to ornament the Escurial and other buildings. At the court of Spain he became a great favourite. After the death of Charles II. he was patronized by Philip V., and in the company of this monarch he returned to Naples in 1702. Here he died in 1705. His most celebrated pieces are his frescoes in the Escurial and at Madrid. Some of his finest paintings are in the gallery at Dresden; many are in the galleries of Naples, Vienna, Madrid, Munich, &c. His works are too numerous to have allowed him time for careful study; few are therefore without fault.

GIORGIONE, properly Giorgio Barbarelli, born in 1477, at Castelfranco, is one of the most celebrated painters of the Venetian school. His master was Giovanni Bellini, and he had Titian as a fellow-pupil. In Venice he ornamented the façades and interiors of several large buildings, as was the fashion at that period, with frescoes, which have mostly perished. His portraits were reckoned among the finest of the Italian school, and he was fond of landscape and mythological subjects. His works did much to gain for the Venetian school its fame for splendour of colouring, and he had renowned scholars and imitators. His genuine pieces are rare. In the National Gallery, London, and in the galleries at Vienna and Dresden, a few are to be seen. He died in 1511.

GIOTTO, called Giotto di Bondone, after his father, a celebrated early Italian painter. Being the son of a peasant in the Florentine village of Vespignano, where he was born, probably in 1266 (or, as Vasari says, in 1276), he was employed, it is said, in tending cattle. But having been once seen by Cimabue, as he was drawing figures of his sheep upon a piece of slate with a stone, that artist obtained leave from his father to take him with him, carried him to Florence, and taught him painting. This may be a mere story, but at any rate his first teacher was Cimabue. His natural talent, and especially the gracefulness so peculiar to him, developed themselves so rapidly that he soon surpassed all contemporary artists. He represented the human figure in his pieces with truth and nature, and excelled in the dignity of his figures, a pleasing arrangement of them, and a regard to correct proportions and natural disposition of the drapery. His earliest extant works are mural paintings in the church of St. Francis at Assisi, executed before the end of the thirteenth century. He was now called to Rome by Cardinal Stefaneschi, nephew of Boniface VIII., and after painting various works there he went to Padua, in 1303, and adorned the chapel of the Annunciata dell' Arena with a series of famous frescoes, including thirty-eight subjects, disposed in three rows, on the sides of the chapel and the front of the chancel wall, with a vast representation of the Last Judgment filling the west end. Dante was his guest at Padua in 1306, and he is celebrated in the great poet's Divina Commedia. He was also a friend of Petrarch. He worked also at Milan, Verona, Ravenna, Rimini, and Arezzo. In 1330–33 he was at Naples, and in 1334 he was appointed master of the cathedral works and other undertakings at Florence, where he designed the celebrated Campanile, a structure that was finished by his scholar and godson, Taddeo Gaddi. Besides the frescoes at Assisi and Padua, comparatively few works of Giotto are extant. Among his most celebrated pieces is the Navicella (ship) at Rome (a picture of Peter Walking upon the Waves, in mosaic). The National Gallery possesses a Coronation of the Virgin painted in tempera,

on wood. Giotto died in 1336 (some say the following year), and left numerous scholars. 'The influence of Giotto was profoundly felt over the greater part of Italy. His example caused a revolution in art, the effects of which are traceable into the fifteenth century.' Many anecdotes of more or less authenticity are told regarding this painter. On one occasion, when asked for a sample of his art to show the pope, Giotto is said to have drawn a perfect circle with a single stroke; whence 'round as the O of Giotto' became proverbial.

GIOVANNI, San, a town in Italy, Tuscany, 20 miles S.E. of Florence, on the left bank of the Arno. It has a cathedral, a parish church, and two female convents. It was the birth-place of the painter Massaccio. Cutlery is manufactured here. Pop. 4220. The same name belongs to several other towns in Italy.

GIOVINAZZO (ancient *Natiolum*), a seaport town in Italy, Naples, province of, and 10 miles N.W. of Bari, on an elevated rock which projects into the Adriatic. It is surrounded by high walls, and is defended by an old castle; is the seat of an archbishop, and contains a cathedral. Its streets are narrow, dark, and dirty, and have a peculiarly dismal and miserable appearance. Carpets are manufactured. Pop. 8556.

GIPSY. See Gypsies.

GIRAFFE. See Cameleopard.

GIRALDUS CAMBRENSIS, an early English historian and descriptive writer, whose proper name was Gerald de Barry, son of William de Barry, a Norman noble who had settled in Pembrokeshire, where Gerald was born about 1146. He received the first part of his education under his uncle, the Bishop of St. David's, and afterwards attended for three years the University of Paris, where he chiefly studied theology and rhetoric. He returned from Paris in 1172, entered the church, and was appointed Archdeacon of St. David's. His uncle the bishop dying soon after, Gerald was elected by the chapter to succeed him, but as the election had taken place without the sanction of the king, he refused to accept the office. The king thereupon ordered a new election to be made, and when the chapter again fixed upon Gerald, the king refused to confirm the appointment. Irritated at this decision, Gerald then withdrew to Paris, where in 1179 he was appointed professor of canon law. But already in the following year (1180) he returned to England, where he was required by the Archbishop of Canterbury to administer the bishopric of St. David's, the proper bishop having proved himself incompetent. He discharged this office for four years, and was then called to the court of Henry II. as royal chaplain, seemingly with the view of preventing his being actually elected to hold the see which he administered. He was afterwards appointed companion to the king's son, Prince (subsequently King) John, and in this capacity accompanied the prince to Ireland in 1185. He took advantage of this visit to collect the materials for his Topography of Ireland (Topographia Hiberniæ). On the occasion of a tour made through Wales in 1188, in company with Baldwin, archbishop of Canterbury, undertaken with the view of stirring up the Welsh to take part in the then projected crusade, Gerald found the opportunity of collecting information for a similar work on Wales (Itinerarium Cambriæ). After the departure of Richard Cœur du Lion for Palestine Gerald remained with William of Longchamp to conduct the affairs of the government, but being dissatisfied with the subordinate rôle which he had to play, he in 1192 withdrew from the court, and retired to Lincoln, to devote himself to learning. On the occasion of the next vacancy in the see of St. David's Gerald was again elected to it, but Richard found means to prevent his installation in the office, even although Gerald made more than one journey to Rome with the object of getting the appointment confirmed. He now retired altogether from the world, and when the bishopric was again offered to him in 1215 he declined it. He was still alive in 1220, but the year of his death is unknown. He was a person of great vanity and ambition, qualities which frequently appear in his writings. He was also remarkable for his credulity, and his Topographia Hiberniæ, although in many respects a valuable work, is full of fables, and met with much censure both at the time of its first appearance and in more recent times. Besides the works already mentioned Giraldus Cambrensis was the author of Historia vaticinalis de expugnatione Hiberniæ, Vita Galfredi, Gemma ecclesiastica, Descriptio Walliæ, Symbolum Electorum, Speculum Duorum, de Rebus a se Gestis, De Principis Instructione, and Speculum Ecclesiæ. The Topographia Hiberniæ, Itinerarium Cambriæ, and Historia vaticinalis have been printed several times. The first is contained in Holinshed's Chronicle; and a translation into English by Colt Hoare was published at London in 1806. All his works, except the De Instructione Principum, were edited for the Rolls Series by J. S. Brewer and J. F. Dimock (7 vols., 1861–77); the omitted work appeared in 1891.

GIRARDIN, Madame Emile de, a lady well known in the literary circles of Paris, both by her writings and conversational talents, was born on 26th January, 1804, at Aix-la-Chapelle, where her father held a government appointment under the reign of Napoleon. Her maiden name was Delphine Gay, and her mother, Madame Sophie Gay, had gained considerable reputation by various novels and dramatic pieces. At an early period Mademoiselle Gay became noted for her *esprit* and poetical talents, and when only seventeen appeared as a competitor for the prize for poetry awarded yearly by the French Academy. The subject was the devotion of the French medical men and sisters of charity during the plague at Barcelona, and though, from her non-compliance with some of the conditions, she excluded herself from gaining the regular prize, an extraordinary one was voted to her for her poem. She afterwards published a volume of poetical essays, and from time to time various metrical works appeared from her pen. In 1831 she married the eminent journalist M. Émile de Girardin, and began now to turn her attention to prose fiction, producing successively Le Lorgnon, Le Marquis de Pontanges, La Canne de M. de Balzac, Il ne faut pas jouer avec Douleur, and Marguerite. She also contributed to the Presse newspaper, conducted by her husband between 1836 and 1848, her Lettres parisiennes, which, under the pseudonym of the Vicomte de Launay, attracted such great and deserved admiration by their wit and liveliness. As a writer for the stage Madame de Girardin obtained some distinction, two of her most successful pieces being Lady Tartuffe and La Joie fait peur, both represented at the Theatre Français. She also composed two tragedies, Judith and Cléopatra, for the celebrated Rachel; and a little piece by her, Le Chapeau de l'Horloger, played at the Gymnase, has become a popular farce in this country under its English title of The Clockmaker's Hat. She died at Paris, after a few days' illness, on 29th June, 1855.

GIRDER, in a framed floor covering a large surface, one of the strong balks or beams which form the main support of the floor, and into which the binding-joists, which are laid at right angles to the girders, are tenoned. The girders are let into the

wall for 10 or 12 inches at either end; but to prevent the ends from decaying they are not built up close round by the wall, but about an inch of free space is left on all sides. A common practice in laying girders is to saw them longitudinally up the middle, and then to bolt the pieces together, a small space being left between the two pieces by the insertion of metal plates or small pieces of wood. The advantage of this practice is not only that it admits of a free access of air, but also that it enables the workman to see that the timber which he uses is perfectly sound at the core, and also to equalize the strength of his girder by reversing one of the halves and bringing the bottom end of one half opposite to the top end of the other. The ends of the girders are supported by transverse pieces of wood called *templates*, which are built into the wall, and the object of which is to distribute the weight over the adjacent parts. When very wide spaces have to be spanned by girders, so that a single piece of timber cannot be got of sufficient length for the purpose, cast-iron girders may be used. These are made with a transverse flange on the upper edge, and a similar one on the lower edge, but broader, in order to resist the extending force which heavy weights placed on the floor exert on it. Where great strength is required, instead of cast-iron girders built-up wooden girders may be used—that is, girders composed of two pieces of wood, of different kinds, placed above one another. In this case the upper beam ought to be of some hard and rigid kind of wood, and the lower one straight-grained and tough. Sometimes what is called a *cambered girder* is built up; that is, the girder is composed of three beams, one above the other, the uppermost being cambered or curved, the middle one being inserted like a double wedge between the uppermost and lowermost, having both ends narrowed to a point, and the lowermost being straight. All three are held together by bolts or straps, and joints may be used where the lengths of timber are not sufficient to stretch between the two walls. In the lowermost beam the joint should be near one end of the span. Another mode of strengthening a girder containing more than one length of timber is to truss it with iron; but this mode is objectionable, as it is liable to have its efficiency destroyed by small changes in the dimensions of the parts.

Girders are now used as much to support the main walls of btildings and the roadway of bridges as to support flooring. For bridges cast-iron girders are sometimes cast in lengths of 40 feet, and even longer; but when the span to be crossed is much longer than 40 feet simple cast-iron girders cannot be used, and recourse must be had to wrought-iron, or to trussed, lattice, or box girders. In wrought-iron girders the upper flange must, unlike that of cast-iron girders, have a larger sectional area than the lower one, since, in wrought-iron, the resistance to compression is less than the resistance to extension. *Box girders* are those of which tubular bridges are constructed. See BRIDGE (TUBULAR).

GIRGENTI, or GERGENTI, a town on the south-west coast of Sicily, capital of the province of same name, 58 miles S.S.E. of Palermo. It has an imposing look, but is poorly built, with steep and narrow streets, the site being 1000 ft. above the sea. There are no manufactures of any consequence, but large quantities of wheat, oil, fruit, and sulphur are exported (at Porto Empedocle, several miles distant). On a rocky platform to the east are the extensive and remarkable ruins of the ancient Agrigentum (which see). Pop. 25,069.—The province of Girgenti has an area of 1490 square miles. It is mostly covered by ramifications of the Neptunian Mountains and intervening fertile valleys. The principal mineral products are bitumen, naphtha, sulphur, salt, and some fine agates. Pop. in 1901, 371,471.

GIRODET-TRIOSON, ANNE LOUIS GIRODET DE ROUSSY, born in 1767 at Montargis, was the most original, versatile, and scientific of the modern school of French painters, and was a scholar of Regnault. He studied, while quite young, at Rome. He obtained the great prize among the pupils of David at twenty-two years of age. A decided inclination to the ancient style and the fulness of statuary is very perceptible in his works; but they are also distinguished for life, nature, and beauty. His drawing is correct, and of great precision; his colouring is rich, transparent, and harmonious. He works with equal care and genius. He loves to produce effect by strong lights, but they are in unison with the spirit of the pieces. The Endymion, which he painted while in Italy, is one of his finest pieces. His Hippocrates (engraved by Massard) is a beautiful specimen of *chiaroscuro*. His Deluge is celebrated, and shows a spark of the gigantic genius of Michael Angelo. His Atala, from Châteaubriand, is charming. He painted Napoleon receiving the keys of Vienna. His portraits are full of truth and strength. He painted, in 1824, the full-length portraits of the Vendean leaders Bonchamp and Cathelineau, the first from a miniature, and the latter from the features of his son, who resembled him. His last great picture represents St. Louis in Egypt. He died at Paris in December, 1824.

GIRONDE, a department of France, bounded N. by the estuary which gives it its name, and the department of the Charente; E. by Dordogne and Lot-et-Garonne; S. by Landes; and W. by the Bay of Biscay; area, 3761 square miles. The surface is generally flat, and consists of three parts, distinguished by their physical features. The first, situated on the right bank of the Dordogne, consists of corn-fields, pastures, plantations, and vineyards. The second part comprehends the district Entre-deux-Mers (so called from its position between the Dordogne and Garonne) and the ancient Benauge, abounding in picturesque beauties, and entitled by its fertility to rank with the fine valleys of the Loire and the Saône. The third part, situated on the left bank of the Garonne, includes the whole sea-coast of the department; and consists chiefly of a parched, arid, and often almost desolate tract, though its sandy gravel, along the Gironde, can boast of raising the vine from which Médoc, one of the first-rate clarets, is obtained. The whole department, with exception of the west, which sends its waters either directly to the coast or the long series of lagoons by which it is lined, belongs to the basin of the Gironde, which is formed in its interior by the junction of the Dordogne and Garonne. The only other streams deserving of notice are the Leyre, which discharges itself into the most southern lagoon; the Ciron, a left affluent of the Dordogne; and the Isle, with its tributary Dronne. The climate differs much in the separate divisions, but is generally characterized by great mildness and a superabundance of moisture. The quantity of waste land is very great, amounting to more than one-third; while the arable land is rather less than one-fourth of the whole surface. Of the remainder about one-seventh is occupied by vineyards, and one-ninth under wood. The corn raised falls considerably short of the consumption, but much hemp and tobacco are grown; and the fruits, consisting chiefly of prunes, figs, and almonds, are excellent. The great staple of production is wine. The most celebrated wines are Médoc, Graves, Côtes, Palus, and Entre-deux-Mers. (See BORDELAIS WINES.) The forests of oak and pine are very extensive. The minerals are unimportant, but large quantities of salt are obtained

from the marshes and lagoons. The manufactures are very various, and include the building of vessels, chiefly large merchantmen; woollen and cotton tissues, delftware, glass, sugar, paper, leather, liqueurs, and articles in iron, steel, copper, silver, and gold. The trade, which has its centre at Bordeaux, is very important. The principal exports are wine, brandy, corn, flour, fruit, rosin, liqueurs, &c. For administrative purposes Gironde is divided into six arrondissements—Bordeaux, Bazas, Blaye, Lesparre, Libourne, and La Réole. The capital is Bordeaux. Pop. (1896), 808,853; (1901), 820,781.

GIRONDE, RIVER. See GARONNE.

GIRONDISTS (French, *Girondins*), one of the great political parties of the first French revolution, which played a distinguished part in the legislative assembly (1791–92) and in the convention. The Girondists were republicans in principle, but they were more distinguished for eloquence, enthusiasm, and a lofty and somewhat visionary ideal of patriotism than for a distinct and well-defined policy of progress; hence they fell an easy prey to the more practical and interested as well as more extreme policy of the Montagnard party. The name Girondists was assigned them because among the most talented and eloquent of their leaders were three of the deputies of the Gironde—Vergniaud, Guadet, and Gensonné. Among others of their distinguished leaders and members were Brissot (from whom the party was named *Brissotins*), Pétion, Ducos, Valazé, Buzot, Barbaroux, Isnard, Lanjuinais, Condorcet, Rabaut-St.-Étienne, Roland, &c. In the legislative assembly the Girondists held a commanding position. They were as yet the chief leaders of the revolutionary party, and the eloquence of their leading orators sustained their reputation, while Brissot, less distinguished as an orator, was influential as a statesman. While the chief conflict lay with the monarchy, the émigrés, the priests, and the foreign powers threatening intervention, the energy and enthusiasm of the Girondists sufficed to carry on the revolution; but a point was soon reached at which the more moderate men began to halt, and then the want of defined principles and a practical policy made themselves felt. Louis XVI. was obliged, in 1792, to select a ministry from among the Girondists. It was short-lived; and on its close dissensions began to break out between the Girondists and the more extreme members of the Assembly, who afterwards formed the Mountain. After the 10th August, 1792, a mixed ministry was formed in which Danton and others of the latter party were included. The massacres of the Royalists in the prisons of Paris (2nd to 6th September) occurred under this ministry, and the Girondists have not been able to escape the responsibility of at least conniving at this atrocity.

In the convention their struggles with the Montagnards forced them, while they still held the semblance of power, into the initiative in extreme measures, which, without the necessity of defending their patriotism, impeached by these deadly enemies, they would not have taken, and thus prepared the way for their own destruction. They wished to save the king, and it was in their power by a united vote to have done so; but many of them, including Guadet, Gensonné, and Vergniaud, from a mistaken policy, voted for his death. While thus constantly yielding to those against whose ultimate views they were continually declaiming, they made the ground beneath them more and more insecure, and when they attempted the impeachment of Marat they completely failed, and that formidable demagogue was sent back triumphant from the revolutionary tribunal, before which they had sent him (24th April, 1793). From this time may be dated the fall of the Girondists. The Jacobins, unable to command a majority in the convention, incited the sections of Paris to appear before that Assembly and demand the proscription of twenty-two Girondists (31st May to 2nd June, 1793). The convention yielded to the pressure, and decreed the arrest of thirty-one members, including the leaders of the party. Many who were not included in the proscription, as well as some who were proscribed, escaped to the provinces, which they endeavoured to raise against the convention, but nearly all of them ultimately perished. Among those who remained and were arrested were Brissot, Vergniaud, Gensonné, and many others, and a decree of arrest was subsequently issued against seventy-three other members who had protested against the proceedings of 31st May to 2nd June. Twenty-one of them appeared before the revolutionary tribunal on the 24th October, 1793; on the 30th they were condemned, and on the following day they were executed. The names of those who suffered were Brissot, Vergniaud, Gensonné, Lasource, Lehardy, Gardien, Boileau, Vigée, Ducos, Boyer-Fonfrède, Lacaze, Duprat, Duperret, Mainvielle, Fauchet, Carra, Duchâtel, Antiboul, Lesterpt-Beauvais, and Sillery. Dufriche-Valazé had, on hearing the sentence, put an end to his life in prison. Guadet, who had fled, was executed at Bordeaux on 17th July, 1794. The condemned Girondists supped together, and passed a great part of the night previous to their execution in conversation, which has been magnified by Charles Nodier into the story of the last banquet of the Girondists. See Lamartine's Histoire des Girondins (8 vols., 1847), and Guadet's Les Girondins, leur Vie Privée, leur Vie Publique, leur Proscription, et leur Mort (2 vols., 1861).

GIRTON COLLEGE, CAMBRIDGE, a well-known college for women in England. Opened in 1869 at Hitchin, it was removed to Girton, near Cambridge, in 1873, and its buildings have been several times extended. There is an entrance examination; the ordinary course extends over three years; and the instruction includes divinity, classics, modern languages, mathematics, natural science, history, music, &c. A 'degree certificate' is granted to those who pass an examination which equals the examination for the B.A. degree in Cambridge University. There is a mistress and six resident lady lecturers, besides many outside lecturers connected with the university.

GIRVAN, a seaport of Scotland, in the county and 21 miles S.S.W. of Ayr, at the head of a fine bay, on the left bank of the Girvan. The chief edifices are the parish and other churches, and the free library. The winter herring-fishery is now the most important industry, but formerly weaving was extensively carried on. The harbour has been improved of late years. Girvan is a popular place of residence for summer visitors. Pop. (1901), 4006.

GISORS, a town of France, in the department of the Eure, 33 miles E.S.E. of Rouen, on the Epte. It contains the ruins of a castle, an old parish church, with fine sculptures, a hospital, a large spinnery and bleachery, manufactures of soldiers' belts, calicoes, &c. Pop. (1896), 4170.

GITSCHIN. See GICZIN.

GIULIANO, SAN, a town of Sicily, on a height, 5 miles E.N.E. of Trapani. In the vicinity, crowning the summit of a hill, are the ruins of the celebrated Temple of Venus Erycina. Pop. 3500.

GIULINI, GIORGIO, antiquary and historian, was born at Milan, 16th July, 1714; died there 24th December, 1780. He studied law at the University of Padua, and received the degree of Doctor. He

published, after elaborate research, Memorie spettanti al governo ed alla descrizione della città e della campagna di Milano nei secoli bassi (twelve vols. quarto, 1760–75), or Memoirs relating to the Government and Description of the City and Territory of Milan in the Dark Ages. The last three volumes form a continuation which brings the book down to 1447. He collected materials before his death for bringing the work down to the sixteenth century. The work is one of great learning, and procured for Giulini the appointment of state-historian of Milan.

GIULIO ROMANO (*Giulio Pippi de' Gianuzzi*), the most distinguished of Raphael's scholars and assistants. He was born at Rome near the end of the fifteenth century. During the lifetime of Raphael he painted with him and under his direction, and his inclination for the terrible and violent was kept within proper limits, but after Raphael's death he followed his inclination more freely. After having finished the great hall of Constantine at Rome, under Clement VII., he went to Mantua at the request of Count Castiglione. He here found a wide field for the exercise of his powerful genius both in architecture and in painting. The palace of the T was ornamented entirely by him, or by his scholars under his direction. The school which he here opened made the principles of Raphael known in Lombardy. After the death of San Gallo in 1546 the building of St. Peter's was committed to him, but he died the same year. While he only aspired to follow his master, he showed himself judicious, graceful, and pleasing; but when he afterwards gave himself up to his own imagination, he astonished all by the boldness of his style, by the grandeur of his designs, by the fire of his composition, by the loftiness of his poetical ideas, and his power of expression. We admire all these qualities united in the Fall of the Titans, in the palace of the T, and in the History of Constantine (at Rome). He is accused of leaving the study of nature for that of the antique style, of not understanding drapery, of a uniformity in his heads, and of a hardness in his colouring. On the other hand, no master has displayed more talent and science in his paintings. His most distinguished scholars were Raphael dal Colle, Primaticcio, and Giovanni Battista Mantovano.

GIURGEWO, or GIURGEVO, a town and river-port, Roumania, on the left bank of the Danube, opposite Rustschuk, 43 miles S.S.W. of Bucharest, of which it is the port. Its citadel, raised on an insulated height, called Slobotzin, surrounded by the Danube, is connected with the town by a bridge. Giurgewo is the most important shipping port on the Roumanian side of the Danube, and carries on a considerable trade with Austria, Germany, Hungary, &c. It was taken by the Russians in 1811, and again in 1829, when its defences were dismantled. The Russians were defeated here by the Turks on 7th July, 1854. Pop. in 1899, 13,978.

GIUSTI, GIUSEPPE, an Italian poet, born at Pescia in 1809; died in 1850. He completed his studies at Pisa, where he took the degree of LL.D. He soon abandoned law for poetry, and being attached to the Liberal party he obtained great popularity by political satires, which were circulated from hand to hand in manuscript, and afterwards printed clandestinely. He is also considered by his countrymen as the rival of Béranger in popular lyrical poetry. His satires were printed at Lugano in 1845, and at Florence in 1847. A more complete edition of his poems appeared at Florence in 1852. He also made a collection of Tuscan proverbs.

GIVET. See CHARLEMONT.

GIVORS, a town, France, department of the Rhône, 14 miles south of Lyons, on the Rhône, the Givors Canal, and near the railway between St. Étienne and Lyons. It is a centre of the coal trade, has large iron-works, glass-works, silk-weaving and dyeing works, and manufactures of fire-bricks, tiles, and pottery. Pop. (1896), 10,057.

GIZEH, GHIZEH, or GEEZEH, a town of Middle Egypt, on the left bank of the Nile, here crossed by a railway bridge, almost directly opposite Cairo. It was formerly an important place, beautified by palaces, but now forms a scene of ruins, amidst which the town is built, having a few cafés and ruined bazaars. Eggs have been hatched here by artificial means since the time of the Pharaohs. Five miles to the west are the great pyramids which have been named from this town, and here also is the famous Sphinx, together forming an attraction for crowds of visitors. Pop. about 11,500.

GLACIERS. The summits and sides of mountains above the limit of perpetual snow are covered with a crust which is harder than common snow, yet not like common ice. More ice is formed on the sides of mountains than on their summits, but this does not constitute the glaciers properly so called. The glaciers are vast fields of ice, extending from the declivities of the mountains down into the valleys below the snow-line, and bearing a considerable resemblance to a frozen torrent. They take their origin in the higher valleys above the limit of perpetual snow, where they are formed by the congelation of large masses of snow in that peculiar condition called by French writers *névé*, by German authors *firn*. The ice of which glaciers are composed is different from that produced by the freezing of still water, and is composed of numerous thin layers filled with countless air-bubbles. It is likewise both more brittle and less transparent than common ice. The glaciers are continually moving downwards into the valleys, and not unfrequently reach the borders of cultivation, sometimes even descending so far as to sweep away villages in their course. The rate at which a glacier moves varies from 18 to 24 inches in twenty-four hours. At its lower end it is generally very steep and inaccessible, the nature of the ground in some cases producing a solid cascade of ice of 1000 feet in height. In the middle part of its course it is more level, but gradually becomes steeper in the ascent towards its source. The appearance presented by a glacier in the middle part of its course is that of a frozen stream with an undulating surface more or less broken up by fissures or *crevasses* of varying length and width. As it descends it experiences a gradual diminution from the action of the sun and rain, and likewise from the heat of the earth in the valley which forms its bed. This last circumstance produces a phenomenon which is universally attendant on glaciers—the issue of a stream of ice-cold turbid water from its lower extremity. The ice being gradually undermined by the action of the water, is scooped out in the form of an arched cavern, and the stream, besides its supplies from the substance of the glacier itself, is fed by the rain-water which percolates from above through the fissures of the ice, and likewise by natural springs from beneath the earth. The descent of the glaciers is shown by the changes in the position of large masses of rock at their sides and on their surface. The former are evidently pushed along by the ice, and near the Grindelberg in Switzerland it has been found by examination that stones have been pushed forward 25 feet in one year. A remarkable series of phenomena in connection with glaciers is presented by the *moraines*, as they are called in Switzerland, consisting of accumulations of stones and detritus, which in some cases are piled up on the sides of the glaciers, in others scattered along their surface. They are

composed of fragments of rock detached by the action of ice and other causes from the sides of the valley which forms the bed of the glacier. Moraines are either *lateral*, when they are formed at the sides of glaciers; *median*, when on the surface of glaciers, in which case they have arisen from the union of the lateral moraines of two united glaciers; or *terminal*, when deposited by glaciers at the lower end of their course. The fissures or *crevasses* already mentioned are due to the unevenness of the ground over which the glacier travels. These crevasses may be either transverse or longitudinal, and are constantly being closed up and renewed. *Glacier-tables*, or large masses of rock supported on pillars of ice, are not seldom seen on the surface of glaciers. The rock represents a former level of the glacier, from which it has subsided through the action of sunshine and other causes, and the ice pillar has been prevented from melting by the rock which rests upon it. The origin of *glacier-cones* of sand and other materials is practically the same as that of glacier-tables. Cavities in the ice through which streamlets of water on the surface of the glacier descend to the muddy current beneath are known as *moulins*.

The most celebrated glaciers of Europe are those of the Alps, which are of the type known as *Alpine*. From each névé field high up in a valley inclosed by steep ridges only a single glacier or 'tongue' proceeds, and this grows narrower and smaller as it descends. The larger glaciers of this type, which occupy a whole valley, are known as *primary glaciers*, or glaciers of the first order, and many of these receive tributary glaciers, or are formed by the union of two or more head glaciers. The total number of glaciers in the Alps is about 2000, of which about 250 are of the first order, and the total area covered by them is about 1500 square miles. The largest is the Aletsch glacier, which is formed on the south-eastern slope of the Jungfrau, between the Aletschhorn and Finsteraarhorn, in the canton of Valais, and flows south-east and south-west towards the Rhone, into which it discharges by the river Massa, near Brieg. It has an area of about 50 square miles, a length of nearly 15 miles, and a mean breadth of nearly 1950 yards, and it receives on the right bank the tributary Middle Aletsch and Upper Aletsch glaciers. Next in size among the glaciers of the Alps is the much smaller Gorner glacier, with a length of fully 9¼ miles, and an area of about 27 square miles. It flows westwards and northwards from the northern part of Monte Rosa towards Zermatt, and, like the Aletsch, belongs to the Rhone valley. The Mer de Glace descends from the northern slope of Mont Blanc towards the valley of Chamouni. It is formed by the union of three head glaciers, the Glacier du Géant (or du Tacul), the Glacier de Léchaud, and the Glacier du Talèfre, and it has an area of about 16 square miles and a length of 9 miles. Only slightly smaller in area than the Mer de Glace is the Viesch glacier, to the east of the Aletsch and the south of the Finsteraarhorn, which discharges into the Rhone below Viesch.

Next in importance, so far as Europe is concerned, to the glaciers of the Alps are those of Norway, which are regarded as forming a distinct type known as Norwegian. Here immense snowfields are found, from each of which many glaciers descend in different directions. The most extensive of these snowfields, and the largest in Europe, is the Jostedalsbrä, to the north of the Sogne-Fiord, which has an area of over 500 square miles. It gives rise to about twenty-four primary glaciers, besides a very large number of secondary ones. Farther south, beside the Hardanger-Fiord, is the second largest snowfield in Norway, known as the Folgefond. Its chief glacier is the Bondhuus, on the south-west. Small secondary glaciers occur on the northern slopes of the Pyrenees, and also on the Sierra Nevada; and immense primary glaciers are found in parts of the Caucasus. There are large glaciers in Iceland and Spitzbergen.

Outside of Europe, glaciers are found in Greenland, Alaska, and other parts of North America; in the Himalaya, Hindu Kush, Karakorum, and other mountains of Asia; in Africa, high up on Kilimanjaro; in the Southern Alps of New Zealand; and in the Andes of South America. The glaciers of Greenland are usually regarded as constituting a type distinct from the Alpine and the Norwegian. They are simply tongues of ice projected down the ice-fiords to the coast from the immense expanse of ice which covers the whole interior of the country, and they travel at a much quicker rate than those of Europe. The two largest are the Jacobshavn glacier at Disko Bay, which is 13 miles long and over 1½ mile in breadth at its end; and the Humboldt glacier at Smith Sound, which is over 60 miles broad. Several of the many glaciers of Alaska are of immense size; notably the Malespina glacier, near Mount St. Elias, 'a plateau of ice having an area of between 500 and 600 square miles', and the Muir glacier, on Glacier Bay, to the south-east of the former, with an area of about 350 square miles. In the neighbourhood of Mount Cook, in the Middle or South Island of New Zealand, there are many large glaciers, of which the most important are the following: Tasman glacier, 18 miles long, over 2 miles broad, and about 21 square miles in area; Murchison glacier, nearly 11 miles long and 1½ mile broad; Godley, Müller, and Hooker glaciers. Icebergs, as is well known, are simply huge pieces detached from glaciers that flow into the sea in the Arctic and Antarctic regions.

Various theories have been put forward to account for the descent of glaciers. The late Prof. J. D. Forbes went in 1841 to the Alps, and with two summers' investigations completed the observations necessary to define the phenomena very correctly, making at the same time careful measurements on the amount of the motion. He showed that a glacier moves downwards very much like a river; the middle and upper parts faster than the sides and the bottom. At the sides and bottom the motion of the ice is retarded by friction. He pointed out the analogy between the way in which the glacier flows down its valley and the way in which a mass of thick mortar or a quantity of pitch flows down in an inclined trough, and he put forward his well-known viscous theory of glaciers, which accounts for the phenomena on the hypothesis that ice is a plastic body.

A mass of ice having been formed in the upper parts of the valley, flows gradually down, owing to its own weight. The middle and the surface move more rapidly than the sides and bottom, as we have said; and while, except here and there, at places where great crevasses form, the ice flows down as one hard mass, the parts of the solid are moving relatively to each other. This, it need scarcely be said, is not a property of any common solid. Ice, according to Forbes, is a mass more like a liquid than a solid. It flows down its bed like a very viscous liquid—like treacle or like pitch, for instance. This, at first sight, is surprising, for everyone knows how brittle ice is. But if anyone will take the trouble to examine a piece of shoemaker's wax and observe how brittle it is, and will afterwards lay the wax on a shelf for a week or two, he will be convinced, by seeing the wax actually flow down, that the brittle-

ness and the plasticity of ice are by no means incompatible. The next question is to explain the plasticity of ice. In that, as we have said, Forbes was not successful; but the explanation has been given by Professor James Thomson. Faraday observed a curious phenomenon respecting ice, well known, it is true, long before to fishmongers and others accustomed to work with ice, but which, till he noticed it, had escaped naturalists. To this phenomenon the name *regelation of ice* has been given. When two pieces of wet ice are put in contact they adhere to each other. The very slightest pressure is sufficient to bring this about. They are found then to be united into one mass. This is the phenomenon of regelation. Faraday was not successful in his explanation of the phenomenon, though he made many very beautiful experiments illustrative of it. It was reserved to Professor James Thomson to explain it thoroughly, and having generalized the principle on which he explained it, to apply this principle to the motion of glaciers. Water, he discovered, when it is subjected to pressure, freezes at a lower temperature than when the pressure is removed. Consequently when ice is subjected to pressure it melts. In melting it gives out cold, if we may use the expression; in other words, a certain quantity of heat is made latent during the melting, and the water, therefore, which comes from ice melting under pressure is cooled below the ordinary freezing-point of water. If it is relieved of pressure, the water again solidifies. It is evident, therefore, that if two pieces of ice are pressed together, the ice tends to relieve itself by melting at the surfaces pressed. Water flowing from the places of pressure out to places where it is relieved of pressure, solidifies again as soon as it has escaped. This explains Faraday's phenomenon of regelation. But farther, Professor James Thomson, extending this principle, showed that ice strained in any way tends to relieve itself of its strained condition by melting at the strained parts; and its substance freezes again when it has relieved itself in this way of the strain applied. This, when applied to the glaciers, gives a complete explanation of their plasticity. Pressed downwards by the vast superincumbent mass, the ice gradually yields. Melting and refreezing takes place at some parts, at others the gradual yielding at strained points goes on. In the latter process there is no visible melting, but there is the gradual yielding from point to point to the pressure above, and there is the transference relatively to each other of the molecules that constitute the, at first sight, solid mass. It is thus seen that ice, under enormous pressure tending to change of form, acts rather like a viscous fluid than like a solid. When however, at particular points, intense strain is put upon it, it is found, as is well known, to be very brittle indeed. It is this brittleness that causes the crevasses that are formed at places where the descent is unusually steep.

GLACIS, in fortification, is the slòping covering of the outer breastwork along the covered way, which descends to the level ground, and covers the ditch upon the outside. It must be so placed that the guns of the fort will rake it at every point.

GLADBACH, or MÜNCHEN GLADBACH, a town of Prussia, province of Rheinland, circle of Düsseldorf, agreeably situated on a height above the Niers, 16 miles west of Düsseldorf. It is the seat of a law-court and several public offices, has manufactures of cotton and mixed cotton goods, silks, common and white leather, copper-wire, tobacco, &c., and numerous mills. Pop. (1895), 53,662; (1900), 58,023.

GLADBACH (BERGISCH-), a town of Prussia, province of Rheinland, 8 miles north-east of Cologne. Manufactures: paper, percussion-caps, and carding woollen yarn. Pop. (1900), 11,435.

GLADE-NET, a net used in forests for the capture of birds, and sometimes of ground-game. It is made of fine netting edged with cord, and suspended from the branches of trees across the glades of the forest. The end of the rope by which it is attached is held by the fowler, and it is suspended with weights, so that it falls immediately on being let go. The wood is beaten to disturb the game and drive them into the glade where the net is fixed. This net is frequently used for the capture of woodcocks.

GLADIATORS were combatants who fought at the public games in Rome for the entertainment of the spectators. They are said to have originated with the Etruscans in the custom of killing slaves at the funeral pyres. The first instance known of gladiators being exhibited at Rome was in B.C. 264, by Marcus and Decimus Brutus at the funeral of their father. They were at first exhibited only at public funerals, but afterwards became common even at private funerals of persons of consequence. They were also exhibited at public festivals and other entertainments. They were at first prisoners, slaves, or condemned criminals; but afterwards freemen fought in the arena, either for hire or from choice. Under the empire persons of senatorial rank, and even women, fought in the arena. The regular gladiators were instructed in schools (*ludi*) intended for this purpose. The overseer of these schools (*lanista*) purchased the gladiators and maintained them. They were hired of him by those who wished to exhibit games to the people. Men of position, especially such as aimed at popularity, sometimes kept gladiatorial schools of their own, and hired lanistæ to instruct them. The gladiators fought in the schools with wooden swords called *rudes*. The person who took charge of a public exhibition of gladiators was called an *editor*, and had magisterial authority. The games were commenced by a *prælusio*, in which the combatants fought with their weapons of wood till, upon a signal, they assumed their arms, and began in earnest to fight in pairs. In case the vanquished was not killed in the combat, his fate was decided by the people. If they decreed his death, the thumb was held up in the air; the opposite motion was the signal to save him. In general they suffered death with wonderful firmness, and the vanquished often exposed himself to the death-blow. If he wished to appeal to the people he raised his hand. When a gladiator was killed attendants appointed for the purpose dragged the body with iron hooks into a room destined for this purpose. The victor received a branch of palm or a garland. The gladiators were often released from further service, and received as a badge of freedom a wooden sword, from which they were called *Rudiarii*. The gladiators were divided into classes according to their mode of fighting: the *andabatæ* fought blindfold; the *caterarii* fought in groups; the *essedarii* fought in chariots, like the Gauls and Britons. There were many other classes, some of them distinguished by fantastic modes of fighting intended to cause amusement.

Gladiatorial Statues.—The most celebrated gladiatorial statues are—1. The gladiator Borghese, which Winckelmann considered to be the statue of a warrior, or of a caster of the discus. Lessing thought it the statue of Chabrias; Nibby supposed it to be the statue of a Gaul from the acroterium of the Temple of Apollo at Delphi, which had been placed there in commemoration of the defeat of the Gauls before the city. It is a combatant with extended arm in the act of warding off a blow. It is a statue of the first rank, made of fine grained marble, and is now in the capitol, to which it was restored from Paris, 1815.—2. The Dying Gladiator, purchased from the Ludovisian collection for the Museum Capitolinum. It is a

dying warrior, according to Zoega, a barbarian, who has received a wound in his breast, and is in the act of falling with an expression of rage.

GLADIOLUS (Latin, a little sword), a genus of plants of the order Iridaceæ, having a bulbous root with a reticulated covering. The leaves are ensiform, strongly veined and sometimes linear, inflorescence spadiceous in unilateral ears, with brilliantly-coloured flowers. The perianth is tubular, with six irregular divisions. There are many species, and they are found in all parts of the old world except India. Those cultivated in Britain are usually planted in March or April, flower in July or August, and are lifted in October. By putting them in pots in winter they may be made to flower as early as May. They are propagated either by seed or bulbs. Medical virtues were formerly attributed to the bulb.

GLADSTONE, William Ewart. See in Supp.

GLAGOLITIC ALPHABET, an ancient alphabet used, along with another known as the *Cyrillic*, in writing the Slavonic languages. The Cyrillic is the modern Slavonic and Russian alphabet; but the Glagolitic is still employed in Istria, Croatia, and Dalmatia, and its use has been authorized in the Roman Catholic liturgies of those districts which are in the Slavonic dialect. It occurs in two different forms, the fuller of which has forty signs. The names of many of the letters have distinguishable meanings. The first four, *azu*, *bukuvi*, *védé*, *glagoli*, mean I, letter, know, speak.

GLAIR, the white of eggs prepared and used as a varnish for preserving paintings. For this purpose it is beat to an unctuous consistence, and commonly mixed with a little brandy or spirits of wine to make it work more freely, and with a little fine sugar to give it body and prevent it cracking, and then spread over the picture with a fine elastic brush. Bookbinders also use it for finishing the backs of books. It consists mainly of albumen.

GLAMORGAN, Glamorganshire, a maritime county in South Wales, having on the north the counties of Brecknock and Caermarthen, on the east Monmouth and the Severn estuary, on the south and south-west the Bristol Channel; area 516,955 acres. The north and north-east parts of the county are extremely mountainous, though none of their summits reaches a great elevation, the loftiest being only 1859 feet high; the others vary from 300 to 1000 feet. The hills in general are barren, yielding little herbage, although here and there verdant acclivities are met with, on which flocks of sheep are pastured. In many places the sides of the mountains are covered with wood, presenting, in combination with narrow valleys and deep glens, scenes of the most romantic beauty. The southern part of the county is level and very fertile, particularly the vale of Glamorgan, the soil of which consists principally of clay, and when well cultivated produces the finest crops of wheat. This fine valley is in many places from 8 to 18 miles in breadth. The climate here is remarkably mild. Snow never lies long on the ground; and the myrtle, arbutus, and other tender shrubs thrive in the open air. Glamorganshire belongs wholly to the basin of the Severn; and all its streams, of which the Taff is the largest, flow, roughly speaking, in a southern direction. Among other streams are the Rhymney (on the eastern border), Tawe, Neath, Ogmore, &c. About half of the total area is under cultivation, and of the cultivated area about nine per cent is under corn crops (chiefly oats), between four and five per cent is under green crops (mostly turnips and potatoes), whilst fully three-fourths are in permanent pasture. The cattle reared in this county are reckoned the best in Wales, with the exception of those of Pembroke. The mineral wealth of Glamorganshire is of incalculable value. Its coal-fields are inexhaustible; and its stores of ironstone and limestone are nearly equally extensive. The smelting establishments of Merthyr-Tydfil (or Tydvil), Neath, Swansea, Aberdare, &c., are among the largest in Britain, and the ironworks of Dowlais and Cyfarthfa are among the finest in the world. The woollen manufacture is carried on to some extent. The county is intersected by canals and railways, which afford ready means of communication throughout the interior. Principal towns—Cardiff, the capital; Merthyr-Tydfil, Swansea, and Neath. The county returns five members to the House of Commons. Swansea town and district returns two members, Cardiff one, and Merthyr-Tydfil two. Pop. in 1881, 511,672; in 1891, 687,218; in 1901, 859,429.

GLANCE, a name commonly applied to opaque minerals, especially ores, of which the high metallic lustre is a conspicuous feature. The following are some of them:—*Antimonial copper glance*, or wölchite, sulphide of antimony, copper, and lead, with arsenic and iron; *antimony glance*, or stibnite, sulphide of antimony; *bismuth glance*, or bishmuthine, sulphide of bismuth, *cobalt glance*, or cobaltine, arsenide of cobalt with sulphur, and with iron, nickel, copper, and antimony; *copper glance*, sulphide of copper; *glance blende*, or manganese blende, sulphide of manganese; *glance coal*, anthracite; *iron glance*, or specular iron, oxide of iron; *lead glance*, sulphide of lead or galena; *nickel glance*, amoibite or gersdorffite, arsenide and sulphide of nickel; *silver glance*, sulphide of silver with copper, iron, &c.; *yellow gold glance*, or sylvanite, telluride of gold and silver; *zinc glance*, silicate of zinc.

GLANDERS, one of the most formidable diseases to which horses are subject. It is indicated by a discharge of pustular matter from one or both nostrils, with a hard enlargement of the submaxillary glands. It is distinguished into acute and chronic. In acute glanders the discharge from both nostrils is so great as ultimately to impede respiration and produce death from suffocation. Chronic glanders may run on for years before it terminates in the acute form of the disease. The discharge is usually confined to one nostril, is only occasional and sometimes trivial, with a moderate swelling of the gland on the affected side. The only other symptom of disease is a harshness of the coat. In the latter stages the discharge becomes offensive. The disease is highly infectious, and acute glanders may be communicated to healthy horses and asses, while the animal first affected is still able to feed and work apparently as well as ever. It may even be communicated to man by the pustular matter coming in contact with any part where the skin is broken; and not a few deaths have happened through this cause. The disease is often difficult to determine, as the discharge is only offensive in the latter stages. The symptoms may be mitigated by tonics and other treatment, but it is rarely if ever cured. By 16 and 17 Victoria, cap. lxii. persons bringing glandered horses into market or turning them into uninclosed lands are liable to a penalty of £20, and, by order in council, the local authorities may order their destruction. The disease is now known to be produced by a species of bacillus. (See Farcy.)

GLANDS, a name formerly given by anatomists to a number of organs of so diverse a character that no definition can apply to them all. Strictly speaking a gland is an organ of the body whose business it is to elaborate from the blood, or to separate out from the blood, some substance for further use in

the body, such as a digestive fluid, or for removal from the body. The essential elements of such an organ are active cells, situated usually on a basement membrane, which may be disposed in a variety of ways, forming a tubular gland, a racemose gland, &c., and in intimate relationship to blood-vessels. The gland is provided with a duct, by which the material produced is removed. The lacrymal glands, salivary glands, mammary glands, the glands of the stomach and intestine, the pancreas and testicle, the sweat glands of the skin, &c., obviously answer to this description. The liver and kidneys are also truly glands in the same sense. But the term gland is still used in connection with structures, which have no excretory duct, because they separate from the blood no material for use or for removal, structures which have been called ductless glands, such as the spleen, the lymphatic glands, the thyroid and thymus glands, Peyer's glands of the intestine, &c., the chief of which have certainly some important part to play in blood formation. Finally, the term gland was formerly applied to two structures, the pineal and pituitary bodies, situated in the brain, now believed to be simply traces of stages in development.

GLANVIL, or GLANVILLE, RANULPH DE, an English baron of the twelfth century, celebrated as a lawyer and a warrior. He was of Norman descent; and in the reign of Henry II. held the office of justiciary of the kingdom. It was at that period that he signalized his valour in repelling the invasion of England by William, king of Scotland, who was taken prisoner as he was besieging the Castle of Alnwick. Richard I., after his accession to the crown, is said to have imprisoned Glanvil, and obliged him to pay for his freedom the sum of £15,000 towards the expenses of a crusade to the Holy Land. The aged magistrate accompanied his master on the expedition to which he had so largely contributed, and perished together with a vast multitude of other English warriors at the siege of Acre in 1190. To Glanvil is attributed an ancient treatise on the laws and customs of England, Tractatus de Legibus et Consuetudinibus Angliæ, written about 1181, and first printed in the year 1554. The best edition of this valuable work is that by Sir Travers Twiss in the Rolls Series (1892).

GLARUS, one of the smallest cantons of the Swiss Confederacy, the seventh in rank, surrounded by the cantons of St. Gall, Grisons, Uri, and Schwyz; area, 266 square miles, with (1898) 33,327 inhabitants, of whom the great majority are Protestants. On all sides, except towards the north, Glarus is walled in by mountains covered with snow. The principal chain, which stretches from the Hausstock to the Scheibe, has a height of more than 8000 feet, and contains many glaciers. There is only one principal valley stretching throughout the canton from north to south, and forming the basin of the Linth. The lakes are numerous, but are less remarkable for their extent than the magnificence of the scenery in their neighbourhood. The inhabitants are distinguished for their industry, the spinning and weaving of cottons being extensively carried on. The surface is much more pastoral than agricultural, and numerous sheep and cattle are reared, while quantities of a special kind of cheese are exported. There are several fertile valleys where good crops of corn are grown. The principal export consists of cotton goods, the manufacture of which is increasing. The minerals are not of much importance. The constitution is a pure democracy. The canton is divided for administrative purposes into seven districts. Glarus belonged for many centuries to the Abbey of Seckingen. It passed to the house of Austria about the year 1299. It joined the Swiss Confederacy in 1352. In 1799 Glarus was the scene of a campaign between the French and Russians. A new constitution was adopted in 1836, amended 1842. The capital, Glarus, situated on the Linth, has 5516 inhabitants. It lies at the foot of the Glärnisch, a mountain 9500 feet high. It has an ancient Gothic church, the pulpit of which was formerly occupied by Zwingli, and which is now used in common by Protestants and Catholics. The green cheese called *Schabzieher* is made here. Woollen, linen, and cotton goods are manufactured. Four miles below Glarus is Näfels, where the Austrians were twice defeated (1352 and 9th April, 1388). The second victory is celebrated by an annual fête.

GLASER, or GLAZER, CHRISTOPHER, a distinguished chemist of the seventeenth century. He is commonly described as a native of Basel, but the date of his birth is unknown. He was brought to Paris by Vallot, physician to Louis XIV. and professor of chemistry in the Jardin du Roi (see DAVISON, WILLIAM, and LEFEBVRE, NICHOLAS), to act as his demonstrator, after the departure of Lefebvre for England, and he was also made apothecary to the king and to the Duke of Orleans. He acted as demonstrator of chemistry for several years, and was for a time instructor of the famous Lemery. Subsequently he was involved in the *cause célèbre* of the Marchioness de Brinvilliers (which see), who was executed in July, 1676, for poisoning a great number of people, and he was immured in the Bastille. Nothing criminal, however, was made out against him, and he was set at liberty. He appears to have then left Paris, and to have died about 1678 or 1679, but nothing is known with certainty on these points. As to his share in the transaction, he probably did little else than sell the drugs, or at most make certain preparations; he does not seem to have known to what use they were put, much less to have had part in their administration. The connection of Glaser with Lemery has been the origin of a very ill-favoured verdict on the character of the former, which has been repeated and exaggerated to Glaser's disadvantage by subsequent historians, but which is strangely in opposition both to the opinion of his immediate contemporaries and to what can now be gathered from his writings as to his knowledge and communicativeness. Thus, by his contemporaries, his appointment to the chemical demonstratorship was highly approved of, and he was much esteemed as a teacher for his clearness and simplicity. These qualities are singularly obvious in the descriptions in his book, and realize what Glaser in his preface states was his aim, namely, to put down only what he had himself tried and succeeded in, so that all who followed his descriptions might be equally successful. When this is compared with the statement, based apparently on Lemery's dissatisfaction, that Glaser was a narrow-minded, mysterious, and suspicious man, greedy of his own ideas, and afraid not only to teach but even to allow what he knew to be guessed, the conclusion is inevitable that the authors of these criticisms either were not conversant with Glaser's treatise or were not willing to do it justice. Glaser's only writing, Traité de la Chymie . . ., was published at Paris, 1663, and not less than ten editions had appeared by 1688 at various places, Paris, Brussels, Lyons. It was translated into German, and also into English, with the title, The Compleat Chymist, or a New Treatise of Chymistry . . . London, 1677. This has been ascribed to Dr. Walter Harris, but without sufficient cause. The book must be looked upon not so much as an exhaustive treatise, even for the time, as partly a summary of the author's theoretical views, partly an outline of certain familiar processes and compounds, but especially as a laboratory guide for

the preparation of various metallic salts and other substances, the processes serving also as a model for other manipulations.

GLASGOW, the largest city in Scotland, and the second largest in the United Kingdom, is situated in the counties of Lanark and Renfrew, on both banks of the Clyde, which flows through it in a westerly direction, while the north-western part of the city is intersected by the Kelvin, a tributary of this river. Much the largest and most populous portion of the city is in Lanarkshire, and of this portion again the greater and more important part is on the right or north bank of the Clyde. Glasgow now forms a county of a city as well as a municipality, and the boundaries were recently extended; but the contiguous police burghs of Partick on the north of the river, and Govan, Kinning Park, and Pollokshaws on the south, with other populous areas, are as yet outside its limits. The city measures about 6 miles from north-west to south-east, and about 5 miles from north-east to south-west, but this includes parks and areas not built on. The ancient nucleus of Glasgow was situated on the north side of the Clyde, but extensions were early made to the south side in the Gorbals and other suburbs. The southern portion of the city mostly occupies low-lying or undulating ground, while the greater part of the northern portion stretches over a series of elevations of varying heights. The chief extension of the city may be said to have taken place from east to west, and its growth is still continuing in that direction (as well as in others), some of the finest residential districts being in the west, such as Hillhead, Kelvinside, and Dowanhill. The central part of the city, on the right bank of the river and for some distance northwards, contains the general business or commercial quarter and the terminal railway-stations. The north and south sides of the river are connected by bridges and ferries, the latter at convenient intervals towards the west, where the shipping traffic on the river makes the erection of bridges impracticable. Proceeding from west to east the following bridges may be noticed: the Caledonian Railway Bridge, leading into and out of the Central Station; Glasgow or Broomielaw Bridge, in line with Jamaica Street, a stone bridge 80 feet broad, recently rebuilt and widened, the features and materials of Telford's earlier structure (1835) being retained; Portland Street Suspension Bridge; Victoria Bridge (stone), Stockwell Street; the Union Railway Bridge (stone and iron), used by the Glasgow and South-Western Railway Company; the Albert Bridge (stone and iron), close to Glasgow's oldest park, called The Green; Rutherglen Bridge; and Dalmarnock Bridge. Tunnels under the river have also been formed for cross-river traffic, and a cable subway running in a circular course twice passes from side to side in this way. There are underground and other local railways, and electric tramways owned by the corporation, running to Paisley and other places beyond the city boundaries.

Glasgow is built mostly of a light-coloured sandstone quarried in the neighbourhood, but a red sandstone, brought from a distance, is now being freely employed. The streets are in general wide and straight, running mostly at right angles east and west, and north and south, or approximately so. Argyle Street with its continuations — east, the Trongate, west, Dumbarton Road—forms a great thoroughfare in the former direction. Sauchiehall Street and Great Western Road (the latter crossing the Kelvin by an elegant bridge) also run east and west, and accommodate a steady stream of traffic. The busiest thoroughfare from north to south is that in the line of Jamaica Street and Glasgow Bridge, while Buchanan Street, also running north and south, is the fashionable shopping street. Of the older streets, Trongate, High Street, and Saltmarket Street are the most celebrated; but modern improvements have entirely changed their appearance. In the older parts of the town there are some localities much too densely populated, and which have been, and to some extent still are, dens of vice and disease; but great ameliorations have been introduced under the City Improvement Act, while the commercial progress of the city has caused, simultaneously with its extension, the rebuilding of a large portion of the central district for the sake of improved warehouse and counting-house accommodation. Though having some unlovely features, Glasgow as a whole is excelled by few cities in the kingdom in architectural beauty and general amenity of appearance. It possesses few squares worth mention, the chief being George Square, in the heart of the city, and Cathedral Square towards the north-east. On the other hand, it has now a series of fine parks and recreation grounds, the former presenting in some cases natural features of no little picturesqueness, and commanding extensive views, besides attractions such as greenhouses, flower-beds, ponds, &c. The chief are: The Green (140 acres), with a People's Palace and winter-gardens; Kelvingrove Park, intersected by the Kelvin; the Queen's Park; Bellahouston Park (178 acres); Alexandra Park; and the one at Thornliebank recently presented by A. Cameron Corbett, Esq., M.P. The city also possesses botanic gardens, with hot-houses, greenhouses, 'crystal palace', &c.

Pre-eminent among edifices stands the Cathedral, Glasgow's only ancient building, situated in the north-east quarter of the city, on the edge of a ravine separating it from the Necropolis (the chief public cemetery). It is a large Gothic edifice in the early pointed style, with tower and spire rising from the centre, but without transepts; length of interior 319 feet; width 63 feet; height of nave 90 feet, of choir 85 feet, spire 225 feet. It is especially distinguished for the beauty of its crypt (or under-church), which is one of the most beautiful in Britain. The windows have been filled by private munificence with painted glass on a uniform plan, those in the nave and choir being by Munich artists, those in the crypt, chapter-house, and Lady-chapel by British artists. The cathedral as it at present stands is supposed to have been begun before 1197, and completed within the fifteenth century. The chancel is used as a parish church, and the structure is under the charge of the government. Many of the other churches are marked by a high degree of architectural merit, but it is difficult to single out any for special notice or to decide which style of architecture predominates: among the more recent perhaps the Gothic, but there are many in other styles, including Greek, Græco-Egyptian, Romanesque, Renaissance, &c. Among other buildings we may first mention those of the University (by Sir George Gilbert Scott) opened in 1870, and covering about 4 acres of ground, on Gilmorehill, a magnificent site in the west of the city overlooking the Kelvingrove Park. The main building is an oblong rectangular pile in the Collegiate Gothic style of the fourteenth century, about 600 feet long by 300 broad, divided into two quadrangles of 180 feet square, united by a centre building, and having a tower and open-work spire about 300 feet high rising from the middle of the south or principal front. The old college gateway in the High Street was taken down and re-erected at the new building, forming an interesting link with the past. Another edifice of similar importance is the Municipal Buildings or City Chambers, ac-

commodating various departments connected with the corporation. This is an imposing structure in the Italian or Renaissance style, occupying a large area, and filling up the whole east side of George Square; it was opened in 1889, and cost about £530,000. Other buildings abutting on the same square are the post-office, Bank of Scotland, and Merchants' House. A large and handsome building adorned with sculpture and statuary, has been erected (at a cost of about £250,000) in the Kelvingrove Park, on the south side of the Kelvin, opposite the University, to serve as a municipal picture-gallery and museum; the city pictures forming a valuable collection comprising a number of works by old masters and modern painters. Among other buildings worth special notice are: the United Free Church College, a building in the Italian style with a high tower; the Royal Exchange, a very fine building in the Corinthian style surmounted by a circular clock-tower, and having a handsome portico; the Stock Exchange, a striking building in the Venetian Gothic style; the old municipal and County Buildings; the Athenæum Buildings, the City Poor House, the Deaf and Dumb Institution, the Christian Institute, the Royal, the Western, and the Victoria infirmaries, the St. Enoch Station and Central Station Hotels (belonging respectively to the Glasgow and South-Western and the Caledonian Railway), the buildings of Glasgow and West of Scotland Technical College, the High School and other scholastic edifices, the Procurators' Hall, several club-houses, banks and insurance offices of a palatial character, besides many of the private warehouses and business premises. In George Square are statues of Queen Victoria and Prince Albert (both equestrian), James Watt, Lord Clyde, Robert Burns, Dr. Livingstone, Sir John Moore, &c., and a tall fluted Doric column surmounted by a statue of Sir Walter Scott. Elsewhere there are also equestrian statues of King William III. and of Wellington, besides an obelisk to Nelson in Glasgow Green, &c. The principal cemetery, the Necropolis, on a rising ground east of the cathedral, is full of fine monuments. St. Andrew's Halls (erected as a private enterprise and now the property of the city) are the finest suite of public halls. The other public halls include the City Hall, the Queen's Rooms, Trades' Hall, &c. There are several theatres and music-halls. There is a public bazaar or market-house for provisions, fruits, &c., near the centre of the city, a fish-market, a large cattle-market, &c.

The only educational institutions we need notice after the university (see next article) are St. Mungo's College; Anderson's College Medical School (founded on a different basis in 1796); the United Free Church College (for divinity students); the Glasgow and West of Scotland Technical College, established in 1886; Queen Margaret College for women, connected with the University; the High School, now under the management of the Glasgow School-board; the Glasgow Academy and the Kelvinside Academy (both proprietary); the normal institutions of the Established Church and United Free Church; a grammar-school for boys and one for girls, connected with Hutchesons' Trust; Allan Glen's School, connected with the Technical College; the Glasgow School of Art; School of Music in connection with the Athenæum; and the Veterinary College. The St. Mungo's College (not as yet provided with special buildings) arose in part out of the need of extending the medical school at the Royal Infirmary, and was opened in 1889, with complete faculties for medicine and law. The Faculty of Physicians and Surgeons, incorporated in 1599, is a body the passing of whose examinations qualifies for general medical practice. The Glasgow School-board has schools that can accommodate over 80,000 pupils, but other school-boards provide for certain portions of the city area.

Glasgow possesses the usual complement of religious, semi-religious, moral, benevolent, and social organizations of a great town, comprising Bible and missionary societies, young men's and young women's societies, temperance league societies, &c. There are municipal lodging-houses, and a municipal 'family home'. Among charitable and friendly institutions a peculiar organization prevails. Nearly every county or district in Scotland has its association of 'natives' in Glasgow, who meet periodically and usually contribute to a benevolent fund. There are similar associations for particular surnames, such as Buchanans, Grahams, and Browns. The fourteen incorporated trades and the Merchants' House are richly endowed for charitable purposes, as is also Hutchesons' Hospital. Of medical charities, the Royal, Western, and Victoria Infirmaries, the Samaritan Hospital for Women, Lunatic Asylum, Maternity Hospital, and hospitals and dispensaries for various diseases may be mentioned, such as the great Ruchill Hospital for fevers. Among literary and scientific institutions we may note the Glasgow Athenæum, with a library, news-room, &c., the Philosophical Society, the Archæological Society, &c. The principal libraries are the University Library (175,000 vols.), the Mitchell Free Library (about 140,000 vols., which are not lent out, however), endowed by private munificence, and managed by the corporation, the libraries of the Faculty of Physicians and Surgeons and of the Faculty of Procurators, the combined Glasgow and Stirling's Libraries (45,000 vols.), and Baillie's Library. The Public Libraries Acts are to be adopted, and Mr. Carnegie has given a donation of £100,000 for the establishment of district libraries. The chief museum is that of the University, known as the Hunterian Museum, being based on that of Dr. W. Hunter, bequeathed to the university in 1783. It comprises coins, anatomical preparations, minerals and zoological specimens, pottery, &c., and is open to the public.

The town-council consists of seventy-five councillors, elected by twenty-five wards, and of the dean of Guild (elected by the Merchants' House) and the deacon-convener of the trades (elected by the Trades' House), as *ex officio* members. The lord-provost, fourteen bailies, and a river-bailie and depute-bailie are chosen from among the councillors. The river and harbour are under the management of the Clyde Navigation Trustees.

The manufacturing industries of Glasgow, including also those of the surrounding and dependent districts, are unequalled for variety by any manufacturing town in the kingdom, with the exception, perhaps, of London. Among the older industries of importance are those connected with cotton, linen, and wool, including spinning and weaving, dyeing and bleaching, calico-printing, and Turkey-red dyeing in particular. But the Glasgow of to-day is most largely dependent upon iron and coal, and the importance of its textile industries is relatively less than formerly. It is the leading market for the whole iron production of Scotland, and there are blast-furnaces and collieries within the city boundaries. The manufacture of malleable iron and steel, and of machinery and metal goods of all descriptions, is immense. The most important industry is ship-building and the connected trades, the Clyde, which was the birthplace of steam navigation in Europe, having ever since been closely associated with the growth and development of steam

shipbuilding and marine engineering. Some 300,000 tons of shipping are usually built yearly, and in 1902 the total output on the Clyde was over 518,000 tons. Locomotive engines constitute another great industry. There are also extensive chemical works, potteries, glass-works, brick-works, breweries, distilleries, tanneries, tobacco-works, confectionery-works, carpet-works, printing, publishing, and lithographic works, and a multitude of other industries of greater or less importance.

The commerce of Glasgow is commensurate in extent with the importance of its manufactures, and is closely associated with these. When Glasgow was unvisited by the foreign buyers who came to the great English markets, the enterprise of its own merchants and manufacturers placed its productions in every important market in the world. The consigning trade, that is, the consignment by manufacturers of their own goods to foreign markets for sale, has consequently here acquired dimensions unusual in English manufacturing towns of the first class, and many wealthy mercantile houses have grown up in the East Indian, American, and other branches of foreign trade. The river itself, the chief highway of this commerce, from being a shallow stream, has by dredging been made navigable for large vessels. Ships loading and unloading here lie partly in the river, partly in docks opening from it, the construction of the latter being a matter of quite recent date. One of these, called the Queen's Dock, is on the north side of the river, and was opened in 1877. It has a length of 3000 and a breadth of 700 feet, with an average depth of 20 feet, and covers 33 acres; length of quays, 3334 yards. A similar dock on the opposite side of the river was commenced in 1890, and was formally opened as Prince's Dock in 1897 by the Duke and Duchess of York. Its water area has an extreme length of 2000 feet and an extreme breadth of 1100, and covers 35¼ acres; length of quays, 3737 yards. One graving-dock is 800 feet long. The harbour revenue is now over £500,000 annually; in 1862 it was only £111,500; in 1800, about £3000.

The total number of vessels that arrived at the harbour of Glasgow in the year 1903 was 10,704, of 3,899,511 tons; the number cleared, 11,459, of 4,478,043 tons; vessels belonging to Glasgow, 1615, of 1,666,934 tons. The amount of customs duty received at Glasgow exceeds £1,500,000; the value of foreign and colonial produce imported in 1903 amounted to £14,408,658, that of the home produce exported was £20,742,110. Large imports of tea, cotton, and other produce are received coastwise from London and Liverpool. The rental of Glasgow in 1904–05 was £5,612,225.

All the leading banks of Scotland are represented in Glasgow by numerous branches, and the Union Bank of Scotland and the Clydesdale Bank have their head offices here, as also have some insurance companies. The principal railway systems are the Caledonian, North British, and Glasgow and South-western, all of which have large modern termini in the heart of the city. There are underground railways, and the cable subway already mentioned, which twice passes under the river. The Forth and Clyde and Monkland Canals form auxiliary means of communication. The traffic on the river and local lines includes a large passenger traffic with the numerous watering-places on the estuary of the Clyde and connected lochs, which in summer attract great numbers of the well-to-do population of Glasgow. In this large river traffic many swift and handsomely-fitted-up passenger steamers are engaged. The tramways since 1894 have belonged to the corporation, and are now worked by electricity.

In a sanitary point of view Glasgow has greatly improved in recent times. The average death-rate of the four years from 1872 to 1875 was 29·85 per 1000. For some years it was generally about 25 per 1000 per annum. In 1887 the rate was a little below 24, in 1902 almost exactly 20, which is above that of London and various other large towns. It must still be admitted, therefore, that the city is not so healthy as it might be; and that its atmosphere is polluted with smoke, soot, and other impurities, and its river with sewage. There is, however, a great difference between the sanitary conditions of different districts, and it is only in the poorer localities, where overcrowding is common and sanitary conditions are neglected, that a high rate of mortality uniformly prevails. The death-rate in these districts is especially unfavourable to children. Much has been done to mitigate this evil, and the sanitary arrangements enforced by the authorities are as efficient as in existing circumstances they can be made. The drainage also is good. The purification of the river has been taken in hand, and extensive works have recently been started by which a large quantity of sewage has its impurities removed before entering the Clyde. Glasgow has long been distinguished for the energy and public spirit of its local government. The trade and commerce of the city, its amenity, and its sanitary condition have all profited in turn by liberally-conceived measures, successive provosts having vied in associating their reign with important schemes of improvement. The improvement of the navigation of the Clyde, which has been already alluded to, was the first and greatest of these schemes of local improvement. Within the memory of people still living, the Clyde was fordable at and below the present harbour of Glasgow, where there is now a depth of 25 or 26 feet. In 1658 the magistrates of Glasgow wished to make a harbour at Dumbarton, but were opposed by the magistrates of that burgh, because the influx of mariners would raise provisions to the inhabitants. In 1662 they purchased the ground on which Port-Glasgow stands, on which they built a harbour and the first dry-docks in Scotland. In 1759 an act of Parliament was procured for making the river navigable by locks, which was fortunately abandoned. In 1770 an act was procured for deepening the river by dredging, and imposing tonnage dues. Since then the opening up of the river highway and the growth of the trade have progressed with uninterrupted success. Up till 1804 Glasgow was supplied with water from thirty public and a few private wells. In 1806–8 acts were obtained for supplying it with filtered water from the Clyde, and this source of supply continued to be used till, from increasing population, the river had changed its character. In 1846 an additional supply was brought in by gravitation from the hills lying south of the city. In 1855 an act was obtained for procuring a supply from Loch Katrine, at a distance of about 30 miles, and the new works were opened in 1859. The outlay on the new works was £930,668, and the purchase and improvement of existing works cost £658,153, making a total of £1,588,821. The rates provided by act of Parliament more than cover the interest on outlay and ordinary expenditure and supply a surplus for new works. The average daily consumption of water has risen from 19,170,000 gallons in 1861 to about 54,000,000 in 1899. By the same year good progress was made with important extensions of the Loch Katrine works, the intention being to raise the possible daily supply to 100,000,000 gallons at an additional expenditure of about £1,000,000. In connection with the water-supply may be mentioned the supply of high-pres-

sure hydraulic power for lifts, &c., now provided by the municipal authorities. In 1866 an act was obtained for the improvement of the city, under which some £2,000,000 has been expended. With this and the Loch Katrine water scheme the names of Provosts Blackie and Stewart are respectively identified. The gasworks belong to the corporation, and the gas is supplied at a low rate. The streets are now partially lighted by electricity, and the corporation has erected great electrical supply works.

History.—Beyond its own commercial growth Glasgow has contributed little to general history. Although unquestionably the most important city of Scotland, it has never been the capital of a county. Its local history is, however, peculiarly rich in characteristic incidents, and at least three of its historians, MacUre, Cleland, and Strang, have acquired a more than local fame. Ancient Glasgow was situated on the high ground immediately around the cathedral, from which it first extended down to the river, and afterwards spread in all directions, but chiefly west and south. The city was for many centuries purely ecclesiastical. Its nucleus has been traced back as far as the origin of the bishopric, founded by St. Mungo about 560. The convents of the Gray and the Black Friars had elegant churches attached to them, one of which at least is supposed to have been earlier than the cathedral. Rottenrow, Castle, Drygate, Kirk, High, Saltmarket, Gallowgate, Bridgegate, and Trongate Streets are known to have been in possession of the public as early as 1100. The bishopric was re-founded by David, prince of Cumberland, in 1115. John Achius, his tutor, who was appointed bishop, is said to have begun the cathedral. In 1176 weekly markets and annual fairs were instituted by the Prior of Grayfriars. The city was erected into a royal burgh in 1180. Provost and bailies are mentioned in a charter dated 1268. One of the earliest trades in Glasgow was salmon-fishing, and the corporation of fishers was probably the earliest trade incorporation. The first Stockwell Street bridge was built by Bishop Rea in 1345. In 1350 St. Ninian's Hospital for lepers was founded. In 1393 a mint was erected in Drygate Street. The tower of the cathedral was commenced by Bishop Lauder in 1408. In 1546 the shipping of Glasgow is mentioned in an order of the privy-council. Some persecutions occurred in Glasgow during the period of the Reformation. The Confession of Faith was signed by 2250 persons in 1581. From this time till about the time of Cromwell's visit in 1650 the most powerful governing body in Glasgow appears to have been the session, which issued its orders on all manner of subjects with a refreshing ignorance and contempt of law. The General Assembly which abolished episcopacy met in Glasgow Cathedral in 1638. Until 1609 the provosts of Glasgow were country gentlemen. The Stuarts of Minto held the post for a good many generations. After the date mentioned the country provosts were succeeded by 'creditable burgesses and trading merchants in the city.' Two great fires devastated the city, in 1652 and 1657. Up till the Union the trade of Glasgow was chiefly with the Continent. Its shipping in 1656 consisted of twelve vessels of 957 tons, in 1692 of sixty-six vessels of 1182 tons. The Union opened up the trade with the American colonies, and when it was temporarily closed by the war of independence the Glasgow merchants had already enriched themselves by the tobacco trade, and were able to turn their capital into new channels. The Govan colliery was opened in 1714. In 1748 the first delft work was erected, and in this work in 1763 Watt set up the model of a steam-engine. The steam-engine was introduced in a cotton-mill in Glasgow in 1792. The power-loom being now introduced, the city soon became an important centre of the cotton manufacture. In 1816 the first vessel was despatched to the East Indies. Since then the trade has extended all over the world, the improvement of the river keeping pace with this extension. The cotton manufacture reached its highest point about 1860, and since then has steadily declined, but ship-building, engineering, &c., have more than made up for this. In 1888 a successful exhibition was held, and in 1901 a still larger one was held with even greater success, the total number of admissions being about 11,500,000. The progress of Glasgow will be seen from the following figures of population:—1610, 7644; 1660, 14,678; 1708, 12,766; 1740, 17,034; 1763, 28,300; 1785, 45,889; 1801, 77,385; 1811, 100,749; 1841, 255,650; 1871, 477,732; 1881, 511,415; 1891, 565,714. Before the end of 1891 the boundaries were extended, and the population thus increased to 656,946; in 1901 it was 760,406, or with the adjoining suburbs, over 900,000. Glasgow sends seven members to Parliament (previous to 1885 it sent only three), Govan and Partick also returning one each.

GLASGOW UNIVERSITY, a corporate body, which was founded by a bull of Pope Nicholas V., dated 7th January, 1450–51, as a 'studium generale tam in theologia et in jure canonum et civili quam in artibus et in quacunque licita facultate,' with the power of creating masters and doctors, who, together with the readers and students, were to enjoy the same privileges and immunities with the University of Bologna. It is in accordance with the educational notions of the day that natural science should be only implicitly included in the 'quacunque licita facultate.' A body of statutes was prepared, and the university established by the bishop and chapter in the same year. The university appears at first to have had neither property nor endowment. A purse was formed of the perquisites procured from matriculations, examinations, degrees, &c., and some of the earlier members bequeathed the patronage of a few small chaplaincies; but through the zeal of its founders, and the civil and ecclesiastical immunities accorded to it, the new school of learning prospered, though in circumstances so little in accordance with modern notions of educational requirements. The clergy were induced to attend by exemption from taxation and residence. The lectures in theology and in canon and civil law were read at the Convent of the Dominicans; but the students of arts soon became so numerous that a house was provided for their residence called the pædagogium, and regular teachers were appointed. The pædagogium was on the south side of the Rottenrow, apparently on the property of the Bishop and Chapter. In 1460 James, Lord Hamilton, bequeathed to Duncan Bunch, regent of the College of Arts, and his successors, a tenement in High Street, with four acres of land adjoining, for the use of said college. On this ground the classes of the university continued to meet for 410 years. In 1577 James VI. prescribed rules for the government of the university, and made a considerable addition to its funds. This new charter is called the Nova Erectio. It provided for a principal to teach theology and Holy Scriptures, who was also professor of Hebrew and Syriac; and three regents, of whom one taught Greek and rhetoric; another dialectics, morals and politics, with arithmetic and geometry; the third, physiology, geography, chronology, and astrology. Between this period and the Restoration the University continued to flourish, and the number of its professors increased; but at the Restoration the re-establishment of Episcopacy deprived it of a great part of its revenues, and three of its chairs

fell into abeyance. After the Revolution it continued gradually to expand the scope of its teaching, and has numbered among its professors and graduates many distinguished men. In the end of the eighteenth century it obtained by bequest the valuable anatomical museum, library, and other collections of the famous Dr. William Hunter. Latterly the old buildings became quite inadequate, and were sold to the Union Railway Company in 1864 for £100,000. A grant of £120,000 for new buildings was procured from government, a small sum was available from college funds, and public subscriptions were procured. In 1870 the classes and professors migrated to new buildings at Gilmorehill, which have cost over £500,000, including £40,000 from the Marquis of Bute for the erection of a common hall; £70,000 under a bequest from Charles Randolph, and other sums. It has an annual allowance from government of £20,880.

The University of Glasgow comprises five faculties, namely arts, science, medicine, law, and theology, the faculty of science having been recently added. The oldest chairs are those of moral philosophy, 1577; natural philosophy, 1577; logic and rhetoric, 1577; Greek, 1581; divinity, 1630; Latin, previous to 1637; mathematics, revived 1691. In the first twenty years of the eighteenth century six professorships were either originally founded or revived, namely, Latin, Oriental languages, civil law, medicine, church history, anatomy; astronomy was added in 1760. The remaining eighteen professorships were founded in the nineteenth century.

The university was reconstituted by the Scottish University Act, 1858, and a similar revolution has been effected under the act of 1889. In regard to administration, course of study for graduation, and the modes of granting degrees, all the Scottish universities are now upon a similar footing, and the particulars already given in regard to Edinburgh University apply also to Glasgow. In 1892 women were admitted to graduation, and the Queen Margaret College for women was incorporated with the university. The present constitution of the university authorities may be thus summarized. The chancellor is head of the university. He is elected by, and presides over the general council. The office of vice-chancellor, who has power to grant degrees in the absence of the chancellor, is usually held by the principal. The general council is constituted as in Edinburgh. It numbers about 5500, and together with the University of Aberdeen returns a member to Parliament. It has the power of making representations to the University Court. The rector is official president of the University Court. He is elected by the students, divided into four *nations*, and when there is an equality of nations the majority of votes decides. The nations are: Glottiana, comprising students born in the county of Lanark; Transforthiana, in counties north of the Forth; Rothesiana, in Bute, Renfrew, and Ayr; Loudoniana, in all other parts. The election is triennial, on 15th November. This division into nations dates from near the origin of the university. The University Court consists of the rector, principal, lord provost of Glasgow, chancellor's assessor, rector's assessor, assessor nominated by the town-council of Glasgow, four assessors each by the general council and senatus (or senate). The University Court is a corporate body in which is vested all the property of the University; it is also a court of appeal from the senate. The principal is elected by the Crown. He is the president of the Senatus Academicus. The senatus includes the whole of the professors. It superintends the teaching of the university.

The matriculated students for the session 1897–98 numbered 1820. There are numerous bursaries connected with the university, the annual total value of which is about £8000. There are also medals and prizes given in connection with the various classes, and scholarships or exhibitions are awarded to students who prove successful in certain examinations. The Snell Exhibitions, established in 1677, send ten (or fewer) Glasgow students to Oxford. They are tenable for five years, and each exhibition yields £80 per annum. The two Eglinton Fellowships, founded in 1862, tenable for three years, and each worth £100 annually, are awarded by competition to students who have just graduated in arts. Three Euing Fellowships, of the value of £80 per annum, and tenable for not more than five years, are also awarded by competition among graduates in arts. The Luke Fellowship, about £80 per annum, tenable for three years, is awarded to graduates for excellence in English literature and history. The George A. Clark Scholarships, four in number, are tenable for four years, their annual value being about £180. The examinations are respectively in classical literature, mental philosophy, mathematics, and natural science. The Metcalfe Fellowship, founded 1870, annual value £100, tenable for three years, is designed to encourage studies in higher mathematics, practical astronomy, civil engineering, and chemistry. There is also the Black Theological Fellowship worth £140 annually.

GLASS doubtless owes its origin to chance. Pliny tells a story of some Phœnician sailors whose vessel, laden with natron, was driven on the Syrian coast, and who, lighting a fire on the sand, and supporting their kettles with lumps of the natron, found pieces of glass among the ashes. This, according to him, was the origin of glass, but we need not put implicit credence in the story. The same writer informs us that Sidon was the first city distinguished for its glass-works, and that the manufacture of glass was not introduced into Rome until the reign of Tiberius. He further states that in the reign of Nero the art of making vases and cups of a white transparent glass was invented. The ancient Egyptians carried the art to the highest perfection, and are known to have practised it as early as 1600 B.C., if not earlier. De Pauw is of opinion that the glass-works at Diospolis, capital of the Thebaid, were the first regular manufactory of this material. The Egyptians, according to the same author, performed the most difficult operations in glass-cutting, and manufactured cups of glass of an astonishing purity, one kind being supposed to have been ornamented with figures in changeable colours. Winckelmann says that the ancients in general made much greater use of glass than the moderns. Besides the ordinary utensils, of which a great quantity have been found in Herculaneum, we find many funeral urns constructed of it. Some of the fragments of cups examined by Winckelmann appeared to have been cut, some of the raised ornaments having the appearance of being soldered to the surface of the vessels, and bearing marks of the lapidary's wheel on their facettes. The ancients used glass to ornament their rooms; for this purpose they employed it of various colours, and composed a sort of mosaic of it. Some blocks of glass used for paving rooms have been found, of the thickness of a common-sized brick. Winckelmann cites some specimens of mosaic of remarkable beauty and delicacy. One of them represented a bird on a dark and coloured ground. The colours of the bird were very brilliant and various, and the whole effect very soft. The artist had made use of opaque or transparent glass, according to the exigencies of the case. What was not the least remarkable was that the reverse offered precisely the same figure without the

1–12 Forms assumed by a Drinking-glass in process of Manufacture. 13 Fritting Furnace. 14, 15 Crucibles. 16 Cuvette. 17 Forceps. 18 Bottle-mould. 19 Spreading and Annealing Furnace. 20, 21 Pump.
22–25 Different Stages in Manufacture of Broad or Sheet Glass. Centre piece: General View of Interior of a Glass-work.

slightest difference in the details. The most valuable remains of the ancients in glass are the impressions and casts of sculptured gems both in sunk and raised work, and the larger works in relief. The glass casts of intaglios often imitate the veins of different colours in the original. These pastes have preserved the impressions of many beautiful gems which are lost. Of the larger works in relief we have only some fragments: they served as ornaments to the walls of palaces. A fine work of this kind is a cameo preserved in the Vatican, an oblong tablet of glass, about 8 inches by 6, representing Bacchus and Ariadne, with two satyrs. But the most beautiful specimens of this art, in which the Roman artists excelled, are the vases adorned with figures in relief: they were sometimes transparent, sometimes of different colours on a dark ground, and so delicately executed, that they were hardly to be distinguished from the vases of sardonyx. The Portland vase is almost the only one of this sort preserved entire. It was formerly called the *Barberini vase*, as it belonged to the Barberini Palace at Rome. It is about 1 foot high, and was at first described as a sardonyx. (See PORTLAND VASE.) The ancients were also acquainted with the art of painting on glass. (See GLASS-PAINTING.)

The manufacture of glass was well understood long before it was thought of making windows of it. The Chinese formerly made use for windows of a very fine cloth covered with a shining varnish. They had also the art of working out the horns of animals into large and thin plates, which they employed in their windows. In Rome the *lapis specularis* supplied the place of glass, and from the description, seems to have been nothing but thin leaves of talc. Rich people had the windows or openings in their baths filled with thin plates of agate or marble. It appears that glass was used for windows by the time of Titus, because fragments of glass plates and panes set in lattice-work have been found at Pompeii, which town was destroyed in his reign; but the first certain information of this mode of using glass is to be found in Lactantius, in the third century A.D. St. Jerome also speaks of it being so used (422 A.D.). Benedict Biscop introduced glass windows into Britain in A.D. 674, though they may have previously been introduced by the Romans. In France, talc or isinglass, white horn, and paper soaked in oil, were anciently used instead of glass. The art of making glass seems to have spread over a considerable part of Europe during the time that the Roman empire lasted, but how far it continued to be practised during the darker ages is uncertain. In France it can hardly have died out at any time, but when it began to be commonly used for windows is doubtful. Æneas Sylvius accounted it one of the most striking instances of splendour which he met in Vienna in 1458, that most of the houses had glass windows. Felibien says that in his time (1600) glass disks were set in the windows in Italy. In France, on the other hand, there were glass windows in all the churches in the sixteenth century, though there were but few in ordinary dwelling-houses.

The Venetians were long celebrated for their glass manufacture, which was established before 700 A.D. Germany and France succeeded to the pre-eminence. Britain did not become distinguished for her glass until about the commencement of the sixteenth century, when the manufacture of window glass was begun in Crutched Friars, London (1557). The British Plate-glass Company was established in 1773, at Ravenshead, in Lancashire. Before this all British plate-glass was imported from France, but the British manufacture is now superior to any other nation in Europe. The excise laws relative to the glass manufacture were at one time complicated in the extreme, enforced under heavy penalties, very numerous, and tended evidently to check the improvement of this highly useful branch of industry in this kingdom. These laws were repealed in 1845 by Sir Robert Peel, as part of his free-trade policy, and beneficial effects were immediately apparent in the improved quality, cheapness, and greater variety of descriptions of glass produced. In 1899 the exports of glass from Britain were of the value of £916,000, the imports of glass £1,617,895.

Glass is formed by the fusion of siliceous matter, such as powdered flint or fine sand, together with some alkali, alkaline earth, salt, or metallic oxide. The nature of the glass will depend upon the quality and proportion of the ingredients of which it is formed; and thus an infinite variety of kinds of glass may be made; but in commerce five kinds are usually recognized, that is:—1. Bottle or coarse green glass. 2. Broad, spread, or sheet window-glass. 3. Crown-glass, or the best window-glass. 4. Plate-glass, or glass of pure soda. 5. Flint-glass, or glass of lead. Coloured glass may be mentioned as a sixth kind.

The physical properties of glass are of the highest importance. One of these is that of preserving its transparency in a considerable heat, and remaining almost entirely without extension. Its expansibility is less affected by heat and cold than that of any other solid substance which has been accurately examined. Its great ductility, when heated, is also a remarkable property. It can, in this state, be drawn into all shapes, and even be spun into the finest threads. As is well known it is readily cut by the diamond.

Before describing the process of manufacturing the different species of glass, it will be necessary to premise a few particulars relative to the construction of glass-houses, furnaces, and the pots or crucibles in which the materials are fused.

Glass-houses are commonly constructed of brick, and made of a conical form, the diameter of whose base varies from 80 to 100 feet, the perpendicular height being nearly the same. A large vault is made in the interior of this cone, extending from side to side, and of sufficient height to allow workmen to wheel in and out rubbish from beneath the furnace, which is placed over the vault, and separated from it by means of an iron grating, on the upper side of which the fuel is laid. The construction of furnaces is a matter of the greatest moment, and much judgment is required in the selection of such materials as shall best resist the destructive effects of the high temperature to which they are subjected, as likewise in determining the form best fitted for the conduct of the operation and the economy of fuel. Three different furnaces are often employed by the glass-maker: 1st, The *calcar* or *fritting* furnace, of which we give an illustration, is that in which the materials used for the formation of the glass are calcined, and a chemical union between the ingredients commenced, forming what the workmen call a *frit*. This furnace is in fact an oven, the fuel being placed at one side, and the flame made to reverberate from the crown or roof back to the frit, care being taken to keep the heat at first below that point at which the alkali would volatilize, and throughout below that point at which the frit would be fused. 2nd, The *working furnace* is that in which the frit, placed in earthen pots or crucibles, is melted and formed into glass. These crucibles are commonly of Stourbridge clay, carefully freed from impurities, powdered and worked with warm water, and steeped

in a cistern until brought to the consistence of a paste. It has been found highly conducive to the durability of these crucibles to form them of a mixture of the Stourbridge clay with the powder of old crucibles in the proportion of about five parts of the former to one of the latter, and this practice is now universally adopted. After the crucibles have been formed of the required shape and dimensions, they are left in the apartment where they have been made for at least a year, in order that they may be completely dried, and then they are subjected to the action of a furnace, the heat of which is made gradually to increase until the temperature has nearly reached that of the working furnace. The size and shape of the crucible will vary according to the purpose for which it is intended. The usual dimensions of these crucibles is, depth 40 inches, diameter at top 40, and at bottom 30. Those for bottle and crown glass are open at top, as represented in fig. 15, and are made from 3 to 4 inches in thickness; those for flint-glass, shown in fig. 14, are covered at the top and are made from 2 to 3 inches in thickness. The crucibles are placed in the furnace at equal distances from each other round the circumference of the furnace, each pot being opposite to an opening in the wall of the furnace in order that the crucibles may be charged or discharged by the workman from without. The working furnace is of a circular form externally, and made to terminate in a chimney, the interior being an arched dome. The fire on the grating at the centre of the furnace is supplied with air from the vault below, and the flame and hot air having acted upon the crucibles placed round the fire, pass out by the chimney and escape through the top of the glass-house. There are frequently two working furnaces together, terminating in one chimney by means of flues. The kind of regenerative furnace known as Siemens' is now often used, and tank furnaces giving a continuous flow of glass are employed, without pots. All glass and articles made of it have to be treated in a special furnace or oven, the temperature of which is somewhat lower than that necessary for fusion, the glass being suffered to remain for several days, while the heat is allowed to diminish by slow degrees until the fire be quite extinguished. This furnace is called the *annealing furnace*, and the process of allowing the glass to cool there is called *annealing*. Unless this process be carefully managed, the articles formed in the glass house can be of no use, from their liability to break by the slightest scratch or change of temperature.

Common *green* or *bottle glass* is formed of the coarsest materials, such as coarse sea or river sand, lime, and clay, and the most inferior and cheap alkalies, such as soap-boilers' waste, and the slag obtained in the smelting of iron ore. When soap-boilers' waste is employed, it is combined with about a fourth part by measure of sea or river sand; the proportion will depend on the quantity of alkali in the waste. A cheap mixture for this kind of glass may be made of common sand and lime, with a little blue clay and sea salt. The soap waste is calcined, being kept at a red heat for about thirty hours, in an arch of the furnace kept for that purpose. It is then withdrawn and bruised along with the proper proportion of sand, and the mixture being put into another arch is calcined for about twelve hours. The crucibles are now filled with this red hot calcined frit, which being kept at a great heat for twelve or fifteen hours, glass is formed fitted for being fashioned into the required forms. The manipulations of the glass-blower in fashioning bottle-glass into various forms are in general the same as those performed by the flint-glass blower, which we will describe afterwards. Wine and beer bottles, which are required to be all of a certain capacity, are blown in moulds, so that their containing portion may be as nearly as possible of the requisite size. Fig. 18 is a representation of a bottle-mould. When the articles are made they are carried to the annealing furnace. It is worthy of remark that green bottle glass is preferable to all other kinds for vessels required to contain corrosive substances; it is also less fusible than flint glass, and therefore better calculated for many chemical purposes.

Sheet glass is the ordinary description of window glass. This glass is usually formed by a mixture of two parts by measure of soap-boilers' waste, one of kelp, or more commonly of soda-ash, and one of cleaned sand. In France the materials employed are commonly:—sand 100 parts, sulphate of soda 30, carbonate of lime 30, coke to aid in the reduction of the sulphate of soda 5, with some bioxide of manganese to correct the greenish tinge that glass with a soda base possesses. The best English broad or sheet window glass is made of the same materials as crown glass. When these materials have been calcined in the fritting furnace the frit is removed, while red hot, on iron shovels, to the crucibles of the working furnace, where, being kept under the action of a great heat for twelve hours, it becomes fused and fit for being blown. The melted glass is taken out of the crucible upon the end of an iron tube about 5 feet in length. The end of the tube being heated, it is dipped into the pot, and then slightly turned upon its axis, by which means a quantity of the liquid glass collects upon it. The tube is then withdrawn, and should there not be sufficient, it is exposed for a little to the cold air, until its surface harden, when it is returned to the pot, and an additional quantity of glass taken on. The workman then blows in at the other end of the tube, and by blowing and swinging the glass in various ways gives it successively the forms shown in fig. 22, finally making it into a cylinder terminated by two rounded ends. These cylinders may be as much as 5 feet long, but it is difficult to manage one of such a size. The extremity of the cylinder farthest from the tube is next applied to the furnace in order that it may be softened, upon which an opening is blown in it and made regular with the scissors. This opening may also be made by heating the cylinder and then stopping up the tube with the thumb, when the expansion of the air causes the cylinder to burst open at the end. After cooling, the cylinder is placed on a wooden tressel (fig. 23), and the other rounded end is detached by winding round its circumference a thread of red hot glass, which causes a clear fracture. The cylinder is then split parallel to its axis by a diamond, or by drawing along it a red-hot iron rod and then wetting the heated line with the finger. The cylinders have now to be transformed into flat sheets of window glass. For this purpose they are taken to the *flattening* or *spreading furnace* (fig. 19), where they are subjected to a temperature high enough to soften them. During the softening the workman lifts them one after the other upon a flat slab in the middle of the furnace, then with a wooden rod (fig. 24) he spreads out the two sides, after which he smooths the entire surface with the implement shown in fig. 25—an iron bar, terminated by a mass of the same metal with one of its sides highly polished. A rod with a piece of charred wood at the end of it is also used for the same purpose. The sheet is then placed in the annealing furnace or oven, which is commonly a compartment of the flattening furnace. Here it is exposed to a heat rather under that required to soften glass, and being allowed to cool slowly, gets rid of that excessive brittleness which it would otherwise possess.

Crown or the best window glass is differently formed

by different manufacturers. According to Dr. Ure good crown-glass may be made of 20 parts by weight of fine purified sand, together with 33 of the best ground kelp; but the quality will be much improved by the addition of 1½ of slaked lime. Very superior crown-glass is made from 120 parts by weight of white sand, 60 purified pearl ash, 30 of saltpetre, 2 borax, and 1 arsenic, together with a small quantity of manganese. The sand, after being thoroughly washed, is calcined in a reverberatory furnace for eighteen or twenty hours, when it is taken out and immediately plunged into cold water. The sand is then mixed with the other materials in a state of very fine powder, and the mixture is carried to the fritting furnace, from whence it is taken to the crucibles in the working furnace, and there mixed with about an eighth part of its weight of broken crown-glass, called by the workmen cullet. The furnace is heated to a very high temperature, the crucibles being supplied with more frit as that already in melts, until the pots are full. In about thirty hours the whole is converted into liquid glass. The furnace being now reduced in temperature, the glass is allowed to cool a little for about two hours, when the crude matter on the top of the crucible is skimmed off. The workman then introduces the end of the iron tube formerly spoken of, and collects some glass, withdrawing and returning the tube twice or thrice, until he has collected a sufficient quantity, which for window glass is usually about 10 lbs. The tube is now held perpendicularly for a few seconds, with the loaded end down, after which a regular shape is given to the glass by rolling it on a smooth iron table, and the operator, by blowing into the tube, causes the glass to swell into a pear-shaped hollow vessel. It is again heated by being held for a little at the mouth of the furnace, and blown still larger, the end being pressed against an iron bar, which process being repeated several times, the glass assumes a spherical form. This globe is again heated, and the back opposite the end of the rod pressed against a flat surface, and made to assume the form of an oblate spheroid. It is then held over a box, the tube being in a horizontal direction, and an iron rod, called the punty, the end of which has been previously dipped in melted glass, is applied to the centre of the flat side opposite the tube. The punty is then detached by the application of a piece of cold iron, leaving a hole in the spheroid of about 2 inches in diameter. The glass is now held to the mouth of the *flashing* furnace, as it is called, and the tube turned on its axis, slowly at first, but gradually increasing as the glass expands, until it at last assumes the form of a thin circular plate of from 3 to 4 feet diameter, and uniform in thickness, with the exception of a thick part in the centre where the tube is attached, called the bull's-eye. The tube is detached by the touch of a piece of wetted iron and a slight stroke, the plate being laid on ashes; it is then conveyed to the annealing furnace. Little glass of this kind is now made.

Flint-glass or Crystal.—Powdered flint was formerly employed in the manufacture of this species of glass; but from the great expense of this substance, fine white sand has for many years been substituted. The other materials are red-lead or litharge, and pearl-ash (carbonate of potash). In order to correct the green colour given by the oxide of iron which the sand contains, a small quantity of black oxide of manganese, with a little arsenic, is added; and sometimes a little nitre is employed in the composition. A quantity of broken flint-glass is also always added. The following is represented as being a good mixture:—Fine white sand, 300 parts; red-lead, or litharge, 200; refined pearl-ash, 86; nitre, 20; with a small quantity of arsenic and manganese. The sand is thoroughly washed, then calcined, and afterwards passed through a fine sieve of forty or fifty passes in the inch. The materials of which the glass is to be formed are now intimately mixed and pounded, and without being fritted they are at once carried to the crucibles of the working furnace, the crucibles having been previously brought to a white heat; and as the mixture fuses more of the ingredients must be added to fill the crucible. The furnace is kept at a very high temperature, and the whole of the materials being fused, a white scum collects upon the top, called glass gall or sandiver, which must be removed as it forms, and is useful to refiners of metal as a flux. When the glass becomes translucent, in order to render the glass workable the temperature of the furnace is diminished until the glass becomes a tenacious mass, so that it may be drawn out into a filamentous thread. The iron tube is now put into the crucible, and the required quantity of glass lifted out upon its end. The tube is then held perpendicularly with the loaded end nearest the ground, and held for a few seconds, so that the glass extends beyond the end of the tube, after which it is rolled into a cylindrical form on a smooth iron table called the merver or marver (Fr. *marbre*). The workman then gives the glass the form of a hollow globe by blowing through the tube, the process being repeated several times by reheating at the furnace, and blowing until the globe become of the required thinness. The punty, formerly described, is now applied to the end of the glass farthest from the tube, and the tube is detached by touching the glass with a piece of cold wetted iron, and then giving it a smart stroke. The workman now heats the glass on the punty, and sitting down upon a chair with smooth arms, he lays the punty upon them in a horizontal direction, and rolling the punty with his left hand backwards and forwards, he gives the glass a rotatory motion, while with an instrument in his right hand, somewhat resembling a pair of sugar-tongs, he enlarges or contracts the different parts of the vessel until it assumes the requisite shape. The workman is also provided with a pair of shears, a scale of inches, and a pair of compasses, so that he may model the material with the greatest accuracy; and if the vessel be complex in form, the glass must be occasionaly reheated during the manipulation. The article is then detached from the punty, and carried to the annealing furnace. (See the illustrations in the accompanying plate, where are exhibited the various steps in the formation of a drinking-glass, from the first dipping of the iron tube into the crucible up to the glass being finally knocked off the punty previous to being subjected to the process of annealing.)

Many of the articles, after coming from the annealing-furnace, are sent to the cutter or grinder. The operation is performed by putting in motion wheels of various diameter and of various edges, some of which are made of iron, others of stone, and some of wood. The process commences at the iron wheel, whose rim is supplied with sand and water from above, and the utensil being applied to the edge of the wheel, is ground to the required form, and then smoothed on the stone wheel, when it is taken to a wheel where a finer substance is employed for grinding, such as rotten or pumice stone, and at last polished on a wooden wheel with putty or crocus. Rich and delicate designs may be cut or engraved upon the articles by means of small wheels of copper and steel upon which emery is kept constantly falling. Ornamental figures may also be engraved, or rather etched, upon articles of glass by means of hydrofluoric acid, which has the property of eating into the glass. The parts not intended to be acted on by the acid

must of course be protected by a special coating. Surface designs are also made by the sand-blast.

Various ornamental forms are given to the surface of glass vessels by metallic moulds. The mould is usually of copper, with the figure cut on its inside, and opens with hinges to permit the glass to be taken out. Moulded articles are made by two different processes. In the first the workman, after having gathered with his tube the requisite quantity of crystal, introduces it into an open mould, which an assistant closes upon the hot glass; the workman then blows into the pipe to force the glass to take the form of the mould. To obviate the fatigue caused by blowing, a sort of pump is used, which consists of a brass cylinder closed at one end, and having a perforated piston attached to a spiral spring moving in the interior (fig. 20, 21). This is fixed to the upper end of the blowing-tube, and when it is pressed the spring yields, the piston rises, and the air compressed between it and the bottom of the pump enters the tube and blows the glass. In the second process of moulding the melted glass is run into a mould, the interior of which represents the external form of the vessel. A sort of mandril representing the internal form of the object is pressed down by a screw-press, and between this and the mould the glass is forced into the required form, the superfluous material being cut away with scissors. Moulded objects can always be recognized by their angles, which are less sharp than those of cut-glass.

Plate-glass.—The composition of plate-glass is stated by Parkes to be—fine white sand, 720 lbs.; alkaline salt containing forty per cent. of soda, 450; slaked lime, sifted, 80; saltpetre, 25; and broken glass, 425—a mixture calculated to make 1200 lbs. of plate-glass. Another good composition has been stated to be—white sand, 300 lbs.; soda, 200; lime, 30; oxide of manganese, 2; oxide of cobalt, 3 oz.; and fragments of glass equal to the weight of sand. The sand, lime, soda, and manganese are intimately mixed, and fritted for about six hours, and before the process is finished the other ingredients are added. The large crucibles in the working-furnace are now filled, and smaller ones are placed beside them in the furnace, which is then to be raised to the greatest possible heat; when the materials in the large crucibles are thoroughly liquefied and skimmed, the small crucibles are filled with the liquid glass by means of a copper ladle. These small crucibles are not taken out of the furnace for three or four hours. When the glass in the cuvette or small crucible (shown in fig. 16) is deemed fit for casting it is lifted out of the furnace by a kind of forceps (fig. 17), and by means of a crane mounted on a low carriage, moved to a smooth, plane, horizontal table of iron, in which the plate is to be cast. The surface of the glass, previously to being cast, is skimmed, and the outside of the crucible, as well as the casting-table, cleaned. The table has ribs of metal along the sides, of depth equal to the intended thickness of the plate, and a temporary rib is placed at the further end of the table. The contents of the crucible are now poured upon the table, and a large copper cylinder moved along upon the ribs spreads the glass into a broad uniform sheet. Twenty men are required to conduct this operation, during which the room is kept quiet, and as much as possible freed from currents of air, which might injure the uniformity of the plate. On this department of the process Mr. Parkes observes that 'the variety of colours which the plate exhibits immediately after the roller has passed over it renders this an operation far more splendid and interesting than can well be described.' When the plate has set it is examined, and should any bubbles or flaws appear, it is divided by cutting through them; and when fairly fixed it is carried to the annealing-furnace, where it remains for about a fortnight. The plate is now withdrawn, and squared upon the edges by being cut with a rough diamond, and then chipped on the under side. The plate is now cemented by means of Paris plaster to a board, and laid horizontally with its face uppermost, when another plate similarly fixed is inverted over it. Ground flint and water is placed between them, and the upper plate being set in motion by machinery, the surfaces of both plates are ground plane. The sides are now reversed, and in like manner ground with the flint powder, great care being taken that the plates be made uniformly thick throughout. The same process is repeated with emery of successive degrees of fineness, after which the plates are examined, and the flaws cut through, forming the sheet into smaller plates. The polishing is then commenced, which is effected by rubbing the plate with a cushion made of stuffed woollen cloth smeared with wetted crocus or brown-red oxide of iron.

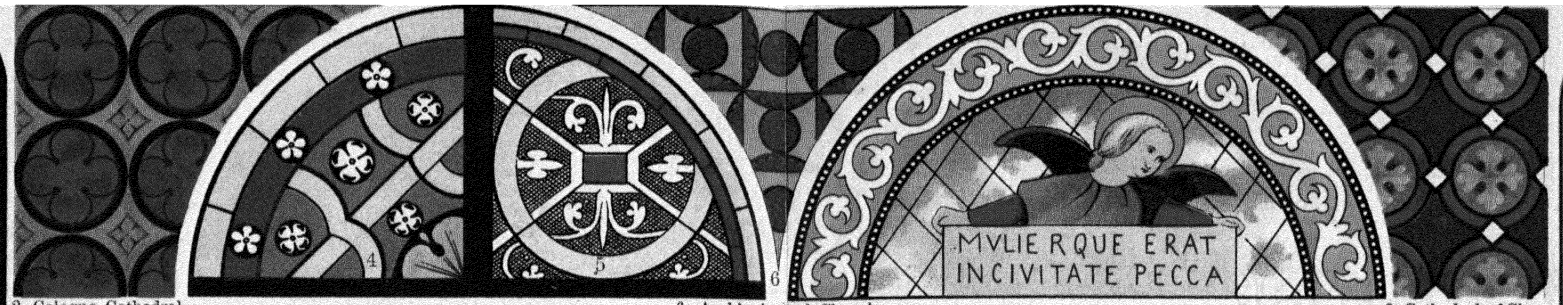
Pressed glass is flint glass formed into articles by pressing into moulds of iron or bronze. *Optical glass* is made of special varieties of flint and crown glass. *Spun glass* is glass in the form of very fine threads or filaments, in which state it may even be woven into fabrics. *Toughened* or *hardened glass*, having certain valuable properties owing to its being heated to the melting point and plunged into an oleaginous mixture, was introduced a short time ago.

Coloured Glass.—Coloured glass is of two kinds—either entirely coloured throughout its substance, the colouring matter being melted along with the other ingredients; or partially coloured, a quantity of white glass being gathered by the workman from one pot, and dipped into the other containing the coloured glass, by which means the whole receives a skin of coloured glass. Transparent patterns on a coloured ground may be produced on articles in this way. The colouring matters are chiefly the metallic oxides, most of which impart a colour to glass; though some non-metallic substances also possess this property. A beautiful yellow colour is imparted by silver in union with alumina (powdered clay and chloride of silver being used), also by uranium and by glass of antimony; red colours are produced by oxide of iron, copper, and gold, the last giving either a ruby, carmine, or pink tint; green may be given by protoxide of iron, oxide of copper, oxide of chromium, &c.; blue is produced by cobalt; orange by peroxide of iron with chloride of silver. Coloured glass is used to a considerable extent in the manufacture of imitation or artificial gems, the particular variety of glass employed being that known by the name of *strass*. Bohemia is particularly famous for its manufactures of coloured glass, and the articles there made are usually no less distinguished for elegance of form than for excellence of colouring.

GLASSITES, a religious denomination which was founded in Scotland in the early part of the 18th century by John Glas, a minister of the Established Church of Tealing, near Dundee, who was deposed in 1728 for the opinions which he delivered in regard to ecclesiastical polity, resembling very nearly those of the Independents. They are sometimes termed Sandemanians, from Robert Sandeman, who joined Glas about 1744. The most distinguishing doctrine held by them is with respect to justifying faith, which Sandeman declared to be 'no more than a simple assent to the divine testimony, passively received by the understanding.' They maintain also certain practices, believed to have been in use among the primitive Christians, such as weekly communions, love-feasts, washing each other's feet, and mutual exhortations. They disapprove of all games of chance,



, King David, Augsburg
athedral(beg.of13th cent.).



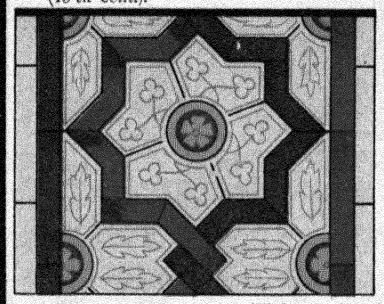
2, Cologne Cathedral (15 th cent.).

4, 5, St. Gudule, Brussels (15 th cent.).

6, Archiepiscopal Chapel, Brussels (16 th cent.).

7, Church of the Annunciation, Arezzo (15 th cent.).

8, Cathedral of Chartres (13 th cent.).



10, Castle of Marienburg (15 th cent.).



18, Swiss Glass-painting of the year 1600 (Museum of Arts, Berlin).



11, Castle of Stolzenfels (15 th cent.).

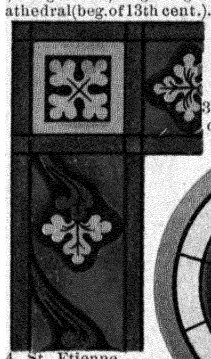


9, Church of Hoogstræten Belgium (16 th cent.).



3, Cologne Cathedral (15 th cent.).

12, Temple Church, London (14 th cent.).



4, St. Etienne, ourges (13- th cent.).

15, St. Etienne, Bourges.

17, German work of the 15 th cent.



13, Temple Church, London (14 th cent.).



16, St. Etienne, Bourge

Printed from the Originals by the Bibliographisches Institut, Leipzig.

and of all use of the lot except for sacred purposes. The Glassites, whose doctrines had found acceptance not only in England but even in America, have declined in numbers since the beginning of the nineteenth century. Faraday belonged to this body.

GLASS-PAINTING, the art of producing pictures upon glass with vitrifiable colours, in contradistinction to the use of coloured glass, in which the colour forms part of the composition of the glass itself. Originally there was but one method of making ornamental glass windows, which was by the latter process: the pieces of stained or coloured glass were cut to the desired shape, and let into the grooves of finely-made leaden frames which formed the pattern in outline, so that the pictures resembled tables of mosaic work, on which there was no attempt at shading or modification of the tone. One of the best known of the early applications of glass to window decoration is that in the monastery of Tegernsee in Bavaria. These windows were executed in the latter half of the tenth century, and, like all the work of that period, are of what may be called the geometric mosaic style. It was not until the thirteenth century that the mosaic patterns gave way to elaborate designs, not only in beautiful arabesque and other styles of decorative art, but even in pictorial composition. In all of these the figures, with the exception of the faces and hands, were made up of pieces of coloured glass combined with great skill and taste. The faces and hands were painted in enamel colours, and burned in. Shading, properly so called, and half-tints, are not attempted. The finest English examples are in Canterbury, Salisbury, and Lincoln Cathedrals, and the five sister lancets of York Minster. Gradually the art of shading by removing certain portions of the coloured surface and other improvements were effected, and the fifteenth century may be called the culminating point in the history of the first period of the art. The finest examples of mediæval glass-painting are the windows of the north aisle of the Cologne Cathedral. By the end of the fifteenth century Gothic architecture, which gave a great impulse to glass-painting, was everywhere dead or dying, and the mediæval spirit which inspired artists of Europe seems to have departed with it. It became the aim of the glass-painters to rival the effects of oil-paintings. Subjects in which were arranged a multitude of personages with all the elaborate artifices of pictorial composition; landscapes with the effects of aerial, and buildings showing complex linear perspective; foreshortened figures; the play of light and shade,—all were attempted to be exhibited in painted windows, and the result was that what would have been impressive on a wall or canvas looked on glass a feeble and shallow transparency. It became apparent in a comparatively short time that the true art was lost, and although windows continued to be painted, only a few artists, especially in France, acquired a certain celebrity. In the reign of James I. Bernhard von Linge, a Netherlander resident in England, and who may be considered the father of the modern art of glass-painting, founded a school whose influence is evident in the works of the present day. There were some artists in the seventeenth and eighteenth centuries who gained reputation by their paintings on glass, as Eginton of Birmingham, Baumgärtner of Kufstein in the Tyrol, and their contemporary Jouffroy. The renovation of the art was contemporaneous with the revival of Gothic architecture in the beginning of the nineteenth century. A number of German artists—Mohn of Dresden, Scheinert in Meissen, and more especially Michael Sigm. Frank of Nürnberg—inaugurated the renaissance, which bids fair to rival the first period of the art. Through the generous assistance of King Louis of Bavaria a school was founded at Munich under the direction of Gärtner and Hess, which has obtained a world-wide celebrity. At the present day the chief seats of the art in Britain are Birmingham and Edinburgh; in France, Paris and Sèvres; and in Germany, Munich, Nürnberg, and Metz. There is a method now in practice of embossing or etching glass by means of asphaltum and fluoric acid; light and shade may be effected by this process by graduating the biting-in, as it is technically called. See Lasteyrie, Histoire de la Peinture sur Verre (1838–56), with 110 coloured plates; Magne, L'Œuvre des Peintres Verriers (1885); Westlake, A History of Design in Painted Glass (Oxford, 1881–94, four vols.).

GLASS-SPONGES. See Sponges.

GLASTONBURY, a municipal borough of England, in Somersetshire, 25 miles south-west of Bath. The more modern houses are well built, mostly of blue lias or brick; many of the older tenements are constructed chiefly, or in part, of stones taken from the ancient abbey. The old market-cross has been replaced by a modern one. There are two handsome parish churches, in the perpendicular style, with graceful towers, and several Dissenting chapels. The town-hall contains an interesting topographical and antiquarian museum. Glastonbury derives its interest and importance solely from the ruins of its once magnificent Benedictine abbey, founded, according to tradition, about the year 60, by Joseph of Arimathea. It was allowed to fall into decay, but was rebuilt by Ina, king of Wessex, about 708, and greatly improved and enlarged chiefly during the twelfth and fourteenth centuries. It consists of some fragments of the church, the chapel of St. Joseph of Arimathea, and what is called the abbot's kitchen. Its abbot lived in almost regal state, had the title of lord, and sat among the barons in Parliament—a greatness brought to a close at the dissolution of the monasteries in 1539, when the last abbot, Richard Whiting, was hanged in his robes, with two of his monks, on the neighbouring eminence of Torhill, by order of Henry VIII., for refusing to surrender the abbey. Glastonbury possesses some chalybeate springs, whose medicinal virtues were once celebrated. Pop. (1891), 4119; (1901), 4016.

GLATZ, a town of Prussia, in the province of Silesia, in the circle of the same name. It stands on both sides of the Neisse, 51 miles S.S.W. of Breslau, contains five churches, a gymnasium, town-house, hospital, and infirmary, and has manufactures of linen, cotton, and woollen goods, red leather, carpets, &c. It is a fortress of the second rank, and was besieged in 1742, 1759, and 1807. Pop. 13,307.

GLAUBER, John Rudolph, was born at Karlstadt in 1603 or 1604. Of his early life nothing is recorded; he apparently received no education to speak of, but was probably apprenticed at an early age to an apothecary. His life seems to have been somewhat unsettled—at least he resided in a number of different places, in Vienna and Saltzburg, in Frankfort, in Kitzingen, in Cologne, and in Basel, and finally in Amsterdam, where he died in 1668. In his late years he supported himself and a numerous family by the sale of special medicines and other chemical secrets. Glauber was a voluminous writer, and published at different places and times his Philosophical Furnaces; The Prosperity of Germany; The Miracle of the World; The Mineral Work; Of the Nature of Salts; and other works. These all appeared in German, and were afterwards translated into French, and by Christopher Packe into English, London, 1689, folio. Glauber's works are distinguished on one hand by acuteness of observation, simplicity of explanation, and directness of descrip-

tion, and on the other by rather far-fetched notions, traditional belief in transmutation, at which indeed he is reported to have laboured for many years, and an occasional appearance of boastfulness. It is difficult not to imagine that Glauber tried to imitate Paracelsus, for whom he entertained great respect, both in his unsettled life, in his absolute unbelief in his contemporaries and dislike to them, in his own self-assertion, and also in the credence he gave to transmutation, to a universal solvent, to potable gold, and other such fancies of the time. He differs, however. from his predecessor in his much greater accuracy and systematic statement of facts and explanations, in his positive discoveries, and in the intelligibility of his writings; but he had none of the reformer's influence which Paracelsus wielded on the medical science and practice of his time. Glauber's writings contain a great number of curious facts and anticipations. Thus he prepared spirit of salt and spirit of nitre by distilling the salts with oil of vitriol instead of with green vitriol itself; and thus also obtained the sulphates of sodium and potassium. He also made sulphate and nitrate of ammonium. He prepared the chlorides of the metals, and corrected erroneous views prevailing with regard to some of them. He had a correct idea of the nature of the mutual decomposition of salts, and applied it to particular cases, which involved for the time a considerable hardihood of opinion: for instance, the action upon a solution of chloride of gold of liquor of flints, that is, of flints dissolved in an alkali. From the result of this action he prepared gold purple. He also pointed out that the same solution could be used with metals to give permanent colours, a seeming anticipation of the modern art of stereochromy. He speaks of the destructive distillation of coal, of the substances thereby obtained and their use in surgery; of the distillation of soot, and the ammonia which it yields; of wood, and the pyroligneous acid which comes over. Numerous observations of this kind are to be met with. In his treatise on the prosperity of Germany he complains, like Palissy, of the ignorance and indifference of his countrymen, who with abundance of the best materials for various arts and manufactures, sold the raw materials cheap to foreign countries, and bought back the manufactured products dear. Glauber, like many other men, received scant justice from the enlightenment of Europe at the end of the eighteenth and the beginning of the nineteenth century. More recent historians, while better acquainted with his defects, have done fuller justice to his merits.

GLAUBER'S SALT, sulphate of sodium, so called because of the importance attached to its chemical and medicinal properties by Glauber. The common account is that he first obtained it in the distillation of common salt with oil of vitriol; for he observed that after all the spirit had been driven off a white saline residue was also obtained, which dissolved in water and could be crystallized. He says it is like water congealed, that it shoots into crystals like saltpetre, but differs from it by not flaming when sprinkled on hot charcoal, and from common salt by not sparking away, and that it has no very marked taste. But the thing which most interested Glauber in his salt, the *sal mirabilis*, as he called it, was his recognition in it of a salt existing in a mineral water near Neapolis, in Austria, from drinking which, he being then a young man and not in good health, derived great benefit. The water was said to contain saltpetre by the country people; but when he afterwards reflected on the subject, he came to the conclusion that it could only be what he called sal mirabilis, and Paracelsus sal enixum. Subsequently the compound was distinguished as *sal mirabilis Glauberi*, or Glauber's salt.

Sulphate of sodium occurring native is called by mineralogists Glauber-salt ($Na_2SO_4, 10H_2O$). It forms oblique prisms efflorescing on the soil or on rocks, of a gray or yellow colour, earthy, but transparent and vitreous when newly broken. It is readily soluble in water, and when heated melts in its water of crystallization. It is found in a great number of localities and in great quantities, both dissolved in the water of mineral-springs—as at Carlsbad and Seidlitz—and of salt lakes, round which it effloresces; in the salt-mines in Austria, in Spain, in Nova Scotia, in Hawaii, &c. For the artificial salt see SODIUM SULPHATE.

The mineral called *Glauberite* is a double sulphate of calcium and sodium, sometimes with a trace of iron and other bodies. It also belongs to the oblique system; it has a pale yellow colour, is vitreous, translucent, brittle, slightly saline; is partially soluble in water, and fuses when heated. It has been met with in Spain, in Austria, in Tarapaca in Peru, and in France.

GLAUCHAU, a flourishing manufacturing town of Saxony, in the circle of Zwickau, on the right bank of the Mulde, 54 miles W.S.W. of Dresden. It is built nearly in the form of a crescent, partly in the hollow of the Wiesenthal and partly on some picturesque eminences; is surrounded with walls, and has a large castle, two churches, a normal and other schools, several charitable establishments, extensive manufactures of woollens, including merinoes, and carpets, linens, and leather, several dyeworks, printfields, and worsted mills. Pop. (1900), 25,677.

GLAUCUS, a fisherman of Anthedon, in Bœotia, who, according to some legends, built the ship *Argo*, and is said to have accompanied Jason as his steersman until he fell into the sea during the fight against the Tyrrhenians. He was received among the national deities of Greece not long before the time of Æschylus, and fishermen and sailors paid particular reverence to him, and watched his oracles, which were considered especially trustworthy.

GLAZING. To prevent the penetration of earthenware vessels by fluids it is necessary that they should be glazed or covered with a vitreous coating. The materials of common glass would afford the most perfect glazing to crockery ware were it not that the ratio of its expansion and contraction is not the same with that of the clay; so that a glazing of this sort is liable to cracks and fissures when exposed to changes of temperature. A mixture of equal parts of oxide of lead and ground flints is found to be a durable glaze for the common cream-coloured ware, and is generally used for that purpose. These materials are first ground to an extremely fine powder, and mixed with water to form a thin liquid. The ware is dipped into this fluid and drawn out. The moisture is soon absorbed by the clay, leaving the glazing particles upon the surface. These are afterwards melted by the heat of the kiln, and constitute a uniform and durable vitreous coating. In general, however, the composition of the commoner kind of glaze is more complicated, borax, Cornish stone, glass, and such ingredients, being present. For very common purposes the vapour of common salt is sometimes all that is required. The fine porcelain glaze ought to be free from lead and from alkalies, and is usually analogous in composition to the biscuit or body of the article. (See POTTERY.) The English and French manufacturers find it necessary to harden their vessels by heat, or bring them to the state of biscuit, before they are glazed; but the composition used by the Chinese resists water after it has been once dried in the air, so as to bear dipping in the glazing liquid without injury. This gives them a great advantage in the economy of fuel.

GLEANING (in law). It has been an almost universal custom to leave the gleanings of the harvest to the poor and to the stranger, in conformity with the positive command of the Mosaic law. In England the custom had almost passed into a legal right, but recently two actions of trespass were brought in the court of common pleas against gleaners in order to try the general question—that is, whether such a right existed. It was decreed that this claim had no foundation in law, the only authority in its support being an extrajudicial dictum of Lord Hale, and that it was a practice incompatible with the exclusive enjoyment of property, and was productive of vagrancy and many mischievous consequences. Notwithstanding this decision, the practice continues to be generally allowed in England, where in some districts the poor are allowed to glean before the harvest is carried, but more generally not till afterwards. With a view to preventing able-bodied labourers rising early in the morning and gleaning in fields from which the grain had only been partially removed farmers in various parts of the country have passed resolutions fixing the hours of the day during which gleaning would be permitted, and excluding all able-bodied labourers between the ages of sixteen and sixty from the liberty to glean. In Scotland it has been established by several decisions that the poor possess no such liberty, at least while the sheaves remain on the field.

GLEBE, in England, is the land possessed as part of the revenue of an ecclesiastical benefice. Various statutes have been passed from time to time to facilitate the exchange of glebe lands, which are often scattered in small parcels in different parts of the parish (5 and 6 Vict. cap. liv.; 17 and 18 Vict. cap. lxxxiv.) If there be both a rector and vicar the glebe land in the occupation of either does not pay tithes, although if occupied by a tenant it does. It was provided as far back as 28 Henry VIII. cap. xi. s. 6 that if an incumbent died after having manured and sown the glebe lands he might make his testament of the profits of the corn; but if his successor be inducted before the severance thereof from the soil he shall have the tithes. It is doubtful whether a parson may open mines upon his glebe, although he may work those already open. In Scotland, as in England, a glebe forms, as a general rule, a portion of every ecclesiastical benefice in the Established Church except in royal burghs proper to which no landward district is annexed. Where there are arable lands the glebe must consist of 4 acres; where there is none the parson is entitled to 16 soums of grass next adjacent to the church—a soum of land being as much as will pasture ten sheep or one cow—so that the actual extent will vary with the richness of the soil. The glebe must be taken as near the manse as possible—a provision as favourable for the heritors as for the minister, the latter not having power to choose remote lands merely on account of the superiority of the soil. Where there is no manse vicinity to the church is the criterion. The presbytery possess the power of selecting lands for a glebe, and the heritor from whose lands the glebe is taken has recourse against the heritors of the same parish. A glebe cannot be alienated by the incumbent, but as the law limits the prohibition to such alienations as might be detrimental to the incumbent's successor, it has been doubted whether the incumbent could not feu. On the removal of a church to a new site the glebe may be disposed of, by sanction of the presbytery, by sale or excambion. The minerals of a glebe are worked under the management of the heritors and presbytery for the behoof of the incumbent for the time. It has been thought that trees growing on the glebe belong to the incumbent.

GLEE, in music, a vocal composition in three or more parts, generally consisting of more than one movement, the subject of which may be either gay, tender or grave, bacchanalian, amatory or pathetic. Instrumental accompaniment is illegitimate, but with unsteady vocalists a piano lightly touched may be of advantage to aid them in keeping time and tune.

GLEIM, JOHANN WILHELM LUDWIG, was born at Ermsleben, a small town in the principality of Halberstadt, April 2, 1719. He lost his father when young, and wrote a poem on his death which shows the early development of his talent. In 1738 he went to the university of Halle, after having been maintained up to that time by charitable persons. Uz was one of his fellow-students and friends; both took the Roman and Greek poets as their models. In 1740 Gleim left the university, and after some time became secretary to Prince William, son of the margrave of Brandenburg-Schwedt. At this period he made the acquaintance of Kleist, another German poet, and became his intimate friend. With Sulzer, Ramler, Graun, &c., they joined the party of Bodmer against that of Gottsched. The second Silesian war, in 1744, separated the two friends; and Gleim, after many vicissitudes of fortune, was appointed secretary of the cathedral chapter of Halberstadt, in 1747, which place he held until his death, 18th February, 1803. He corresponded with all the principal wits in Germany, and enjoyed the affection of all. His correspondence is therefore very interesting. He never married, and his niece, Sophia Dorothea Gleim, whom he has frequently sung, under the name of Gleminde, kept his house. He acquired the greatest reputation by his martial songs, which appeared under the name and in the character of an old grenadier, at the time when Frederick the Great filled all Europe with the fame of his achievements. Two years before his death he became blind. Klopstock wrote an ode to his memory. He was buried in his garden in Halberstadt, and according to his last will some simple urns, with the names of his friends who died before him, are arranged around his own. His works have been published; Gleim's Sämmtliche Werke, erste Originalausgabe aus des Dichters Handschriften durch W. Körte; seven small vols. (Halberstadt, 1811–13). Körte also wrote his life. Part of his correspondence was published in 1894–95.

GLEIWITZ, a town of Prussia, in the province of Silesia, government of, and 39 miles south-east of Oppeln, on the Klodnitz, and the railway from Oppeln to Cracow. It has three churches, a gymnasium, in the buildings of an old Franciscan monastery; several schools, barracks, and two hospitals; and manufactures of linen and woollen cloth, an extensive government iron-foundry, glass-works, a large worsted and other mills, a weekly market, and eight annual fairs. Pop. (1900), 52,362.

GLENCOE, a romantic Scottish valley in the county of Argyle, beginning at Loch Leven and extending from Ballachulish in an easterly direction for 10 miles. The vale is bounded on both sides by almost perpendicular mountains of grotesque forms, 3000 feet high, in the cliffs of which snow lies all the year round. It is traversed by a mountain stream, Ossian's 'dark torrent of Cona,' and it would be difficult to find elsewhere such a scene of utter loneliness, desolation, and sublimity. The valley was the scene of a tragedy known in English history as the Massacre of Glencoe. The state of the Highlands which followed the parliamentary session of 1690 was a subject of great anxiety to the government. Although the Highlanders had ceased any important active operations since the death of Dundee at Killiecrankie, they had not laid down their arms. Lord Breadalbane sent a plan for settling the High-

lands to Sir John Dalrymple, Master of Stair, secretary of state for Scotland, who was then residing with King William in Flanders. It was proposed that a general pardon and £12,000 should be given to the Highlands, and pensions offered to the chiefs on condition of their putting 4000 of their clansmen in the service of government to resist foreign invasion. William readily adopted the plan with some modifications, but it failed in its object, and the government determined to act with more vigour; a proclamation was issued by the authorities in Edinburgh, in the autumn of 1691, exhorting the clans to submit to William and Mary, and offering pardon to every rebel who should swear, on or before the 31st December, 1691, to live peacefully under their majesties, and threatening to treat as enemies and traitors all who refused to do so. All the chiefs hurried to take the oaths before the prescribed time except MacIan, the chief of the petty clan of the MacDonalds of Glencoe, whose submission was not given in to the proper quarter before the 6th of January, 1692. The magistrate, before whom MacIan took the oaths, transmitted a certificate to the council at Edinburgh, which stated that the chief had offered to take the oaths before Colonel Hill at Fort-William within the prescribed period, but that officer not being a magistrate could not receive them, and that the chief had unfortunately exceeded the time granted by six days, owing to the long and toilsome journey before he could reach a magistrate. This certificate was never laid before the council, but was suppressed, it is supposed, by the Master of Stair, an inveterate enemy of MacDonald's. The king's signature was obtained to an order directed to the commander of the forces in Scotland, which ran as follows: 'As for MacIan of Glencoe and that tribe, if they can well be distinguished from the rest of the Highlanders, it will be proper for the vindication of public justice to extirpate that sect of thieves'. On the 1st of February, when old MacDonald believed his peace was made with the government, a party of soldiers, 120 in number, commanded by Captain Campbell of Glenlyon, whose niece had married a son of the old chief, marched up the glen and took quarters as friends, not as enemies. The soldiers belonged mostly to the clan Campbell, and had little affection for the MacDonalds; but they were well treated by their hosts, and all went merrily on for twelve days. At five in the morning of the 13th Glenlyon led on his men to the slaughter of their unsuspecting victims. Thirty men of the clan were murdered, but many who had escaped the carnage perished in the snow, sank into bogs, or died for lack of food. The soldiers then set the huts on fire and departed, driving away with them the flocks and herds of the inhabitants. Much obloquy has been heaped upon King William by some historians, on account of his share in the massacre of Glencoe, but the utmost of what he would seem to have been guilty was a certain amount of carelessness in signing without due investigation the order mentioned above.

GLENDOWER, OWEN, properly OWAIN AB GRUFFYDD (Owen son of Griffith), a celebrated Welsh national leader, was born about 1359 of a family which claimed descent from Welsh princes. His usual English surname is an Anglicized form of Glyndwr, the name of his house in Merionethshire. Owen studied law at Westminster, and afterwards became squire to the Earl of Arundel. In 1385 he served under Richard II. in Scotland, but he afterwards joined Henry of Lancaster, who in 1399 became king as Henry IV. About 1400 Owen had a dispute about land with Lord Grey of Ruthin, and about the same time the latter got him into trouble with Henry by neglecting to hand him a writ of summons to a Scottish expedition. These grievances and his inability to find redress drove him into revolt, and before long the whole of North Wales acknowledged him as Prince of Wales. Henry IV. marched against him, but Owen avoided an engagement. In 1401 he carried the campaign into South Wales, and next year he defeated and took prisoner Sir Edward Mortimer at Pilleth in Radnorshire. Mortimer afterwards joined Ower and married one of his daughters. In September 1402, three English armies invaded Wales, but Owen kept out of their reach while he harassed their operations. After ravaging the country they retreated to England within three weeks. Next year Prince Henry (afterwards Henry V.) led a force against Owen, but he also failed to force an engagement, and had to content himself with despoiling the country and burning Owen's two houses. Owen again advanced south, took and burned Carmarthen, and gained other successes, so that South Wales was soon almost entirely with him. The rebellion of the Percys, who had been negotiating with him, broke out in 1403, but t was crushed by the royal victory of Shrewsbury on July 21st. Whether intentionally or not, Owen failed to arrive in time to assist his allies. In the latter part of 1403 Henry IV. made another fruitless advance into Wales, and in 1404 Owen captured and destroyed Cardiff. He now appointed ambassadors to conclude an alliance with France, and in 1405 the alliance was ratified by him at Aberystwith. In 1405 he summoned a Welsh parliament to meet at Harlech. From this time his power steadily declined. Prince Henry defeated him twice in 1405, and again in 1406. In 1411 Henry IV. offered a pardon to all rebels who would surrender, but Owen and another were exempted. In 1413 Henry V., the new king, issued another proclamation of pardon from which Owen was not exempted, but the sturdy guerilla leader refused to surrender. In 1415, Sir Gilbert Talbot was appointed to treat with him, and next year the same person received powers to treat with his son. Nothing further is known of his career, but it is probable that he died peacefully about 1416. See the account in the Dictionary of National Biography, Wylie's History of Henry IV. (four vols., 1884–98), Tyler's History of Henry V. (vol. i.).

GLENLIVET, a valley or district of Scotland, in the south-west of the county of Banff, about 9½ miles in length. Whisky of a particularly fine flavour has long been made in the district. A locality at the north-west extremity of Glenlivet was the battlefield on which, in October, 1594, the loyal Protestant army under the Earl of Argyle, was defeated by an insurgent Roman Catholic force under the Earl of Huntly.

GLENROY, a deep Highland valley, parallel to Glenmore nan' Albin (the Great Glen of Scotland), and at an average distance of 4 or 5 miles from it, in the parish of Kilmonivaig, in Lochaber, Inverness-shire. It may be regarded as a lateral branch of Glenspean, and is a long, narrow, winding, and steep ravine nearly 14 miles in length, and little more than ½ mile in breadth, through the entire extent of which a rapid stream called the Roy rushes down to join the Spean on the right bank, at the Bridge of Roy. The glen is celebrated for its PARALLEL ROADS, on which various treatises have been written, and which have given rise to many conflicting theories. The commencement of the roads may be observed a few miles from the lower end of the glen, on the hill of Benvanicaig on the left, and a few yards farther forward three lines are seen distinctly, one over the other,

on the hill of Creanachan, on the right. Not only do the lines on the same side of the glen run parallel to each other, but on both sides they occupy the same horizontal level. As he advances, the traveller finds that the lines become more marked, and upon ascending to them discovers that they are ample terraces projecting from the mountain slopes, and composed of a mixture of clay and gravel. These terraces project, at some parts, only a few feet from the side of the hill, and at others swell out into magnificent pathways 18 or 20 yards wide. The lowest terrace is 847 feet above the sea-level; the middle, 1059 feet; and the highest, 1140 feet. The popular notion in the Highlands is that these roads were for the convenience of the Ossianic heroes; Playfair supposed they were aqueducts for artificial irrigation; Macculloch and Sir Thomas Dick Lauder, that they were the shore-lines of fresh-water lakes which gradually washed away their barriers, remaining for a longer period at the height of the various shelves. Darwin considered the glens as ancient arms of the sea, and held that the terraces indicated periods of rest in the upheaval of the lands, an opinion favoured by Dr. R. Chambers. Agassiz, Buckland, and Geikie adhere to Macculloch's theory, but, finding no indication or remains of any land barrier they refer the lake to the glacial period, and hold that two large glaciers came down from Ben Nevis, the one near the centre of the mountain, and the other along the basin of Loch Treig, and that these dammed up the water in a part of Glenspean and in Glenroy. When the lake that filled Glenroy and the neighbouring valleys was at its deepest the surplus water would escape from the head of the glen down into Strathspey, and at that time the highest beach or terrace must have been formed. The Glen Treig glacier then shrank a little, and the lake was thus lowered about 80 feet, so as to form the middle terrace, the outflow now being by the head of Glen Glaster and through Loch Laggan into the Spey. After the lake had remained a time at this height the Glen Treig glacier continued to decline, and at last crept back out of Glenspean. By this means the lowest of the roads was formed, and the waters of Glenroy joined those of Loch Laggan, forming one long winding lake, having its outflow, by what is now the head of Glenspean, into Strathspey. As the climate of the glacial period grew milder, however, the mass of ice which choked up the mouth of Glenspean gradually melted away. The drainage of Glenroy, Glenspean, and the collateral valleys was then no longer arrested, and as the lake crept step by step down the glen towards the sea the streams, one by one, took their places in the channels which they have been busy widening and deepening ever since.

GLENTILT, a narrow mountain valley, 13 miles long, coming down from the northern extremity of the parish of Blair-Athole, Perthshire, south-westward and southward to its southern extremity at Blair Castle, and there opening at right angles into the valley of the Garry. Its upper half is lined by mountains of about 3500 feet high, whose slopes are scored by innumerable torrents bounding down to meet the Tilt, which rushes impetuously through the glen. On its east side, about midway between its extremities, rises the vast Ben-y-Gloe, whose base is 35 miles in circumference, and whose highest summit reaches the height of 3725 feet above the sea-level. The lower half of the vale is less wild. The glen is very interesting from a geological point of view, and has been explored by many distinguished geologists. Marble of a pure white, of a light gray, and of a beautiful green has been quarried in its recesses, and carried away to adorn the mansions in the neighbourhood.

GLOBE, a sphere, a round solid body, which may be conceived to be generated by the revolution of a semicircle about its diameter. (See SPHERE.) *Globe*, or *Artificial Globe*, in geography and astronomy, is more particularly used to denote a globe of metal, plaster, paper, pasteboard, &c., on the surface of which is drawn a map or representation of either the heavens or the earth, with the several circles which are conceived upon them, the former being called the *terrestrial globe*, and the latter the *celestial globe*. The *Celestial Globe* is intended as a representation of the heavens, on which the stars are marked according to their several situations. The *Terrestrial Globe* is an artificial representation of the earth, exhibiting its great divisions. The axis of the earth is an imaginary line passing through its centre, and the wire on which the artificial globe turns represents this line. The poles of the earth are the extremities of this axis; that on the north is called the *arctic*, that on the south the *antarctic* pole. The brazen meridian is the circle in which the artificial globe turns, divided into 360 degrees. Every circle is supposed to be divided into 360 equal parts, called *degrees*; each degree into 60 equal parts, called *minutes*; each minute into 60 equal parts, called *seconds*, &c. A degree is therefore only a relative idea, and not an absolute quantity, except when applied to a great circle of the earth, as to the equator or to a meridian, in which cases it is 60 geographical miles or 69·12 English miles. A degree of a great circle in the heavens is a space nearly equal to twice the apparent diameter of the sun, or to twice that of the moon when considerably elevated above the horizon. Degrees are marked with a small cipher, minutes with one dash, seconds with two, thirds with three, &c.; thus 25° 14′ 22″ 35‴ are 25 degrees, 14 minutes, 22 seconds, 35 thirds. In the upper semicircle of the brass meridian these degrees are numbered 10, 20, &c., to 90, from the equator towards the poles, and are used for finding the latitudes of places. On the lower semicircle of the brass meridian they are numbered 10, 20, &c., to 90, from the poles towards the equator, and are used in the elevation of the poles. Great circles, as the equator, ecliptic, and the colures, divide the globe into two equal parts; small circles, as the tropics, polar circles, parallels of latitude, &c., divide the globe into two unequal parts. Meridians, or lines of longitude, are semicircles extending from the north to the south pole, and cutting the equator at right angles. Every place upon the globe is supposed to have a meridian passing through it, though there may be only twenty-four drawn upon the terrestrial globe; the deficiency is supplied by the brass meridian. When the sun comes to the meridian of any place (not within the polar circles) it is noon or mid-day at that place. The first meridian is that from which geographers begin to reckon the longitudes of places. In English maps and globes the first meridian is a great circle supposed to pass through the Royal Observatory at Greenwich. The equator, a great circle of the earth, equidistant from the poles, divides the globe into two hemispheres, northern and southern. The latitudes of places are reckoned from the equator northward and southward, and the longitudes are reckoned upon it eastward and westward. The equator, when referred to the heavens, is called the *equinoctial*, because when the sun appears in it the days and nights are equal all over the world, namely, twelve hours each. The declination of the sun, stars, and planets is counted from the equinoctial northward and southward, and their right ascensions are reckoned upon it eastward round the celestial globe from 0 to 360°. The ecliptic is a great circle in which the sun makes his apparent annual progress among the fixed stars. It

is the real path of the earth round the sun. The points at which the ecliptic intersects the equator at an angle of 23° 28′ are called the *equinoctial points;* the ecliptic is situated in the middle of the zodiac. The apparent path of the sun is either in the equinoctial, or in lines nearly parallel to it, and his apparent annual path may be traced in the heavens by observing what particular constellation in the zodiac is on the meridian at midnight; the opposite constellation will show very nearly the sun's place at noon on the same day. The zodiac on the celestial globe is a space which extends about 8° on either side of the ecliptic. Within this belt the motions of the planets are performed.

The ecliptic and zodiac are divided into twelve equal parts called *signs*, each containing 30°; and the sun makes his apparent annual progress through the ecliptic at the rate of nearly a degree in a day. The names of the signs, and the days on which the sun enters them, are given in the article ECLIPTIC. The colures are two great circles passing, one through the points Aries and Libra and the poles of the world, the other through Cancer and Capricorn and the poles of the world. That passing through Aries and Libra is called the *equinoctial* colure; that passing through Cancer and Capricorn the *solstitial* colure. The tropics are two smaller circles, each 23° 28′ from the equator, with which they are parallel; the northern is called the *tropic of Cancer*, the southern the *tropic of Capricorn*. The polar circles are two small circles parallel to the equator (or equinoctial), at the distance of 66° 32′ from it, and 23° 28′ from the poles. The northern is called the *arctic*, the southern the *antarctic* circle. Parallels of latitude are small circles on the terrestrial globe parallel to the equator. Every place on the globe is supposed to have a parallel of latitude drawn through it. The hour circle of the artificial globe is a small circle of brass with an index or pointer fixed to the north pole. The hour circle is divided into twenty-four equal parts, corresponding to the hours of the day, and these are again subdivided into halves and quarters. The horizon is a great circle which separates the visible half of the heavens from the invisible, the earth being considered as a point in the centre of the sphere of the fixed stars. Horizon, when applied to the earth, is either apparent or real. The sensible or visible horizon is the circle which bounds our view, where the sky appears to touch the earth or sea. It extends only a few miles. The real or true horizon is an imaginary plane passing through the centre of the earth parallel to the sensible horizon. The wooden horizon circumscribing the artificial globe represents the true horizon on the earth. This horizon is divided into several concentric circles arranged in the following order:—One contains the thirty-two points of the compass divided into half and quarter points. The degrees in each point are to be found in the amplitude circle. Another contains the twelve signs of the zodiac, with the figure and character of each sign; and another contains the days of the month answering to each degree of the sun's place in the ecliptic, and the twelve calendar months. The cardinal points of the horizon are east, west, north, and south. The cardinal points in the heavens are the zenith, the nadir, and the points where the sun rises and sets. The cardinal points of the ecliptic are the equinoctial and solstitial points, which mark out the four seasons of the year; and the cardinal signs are ♈ (Aries), ♋ (Cancer), ♎ (Libra), and ♑ (Capricorn). The zenith is a point in the heavens exactly overhead, and is the superior pole of our horizon. The nadir is a point in the heavens exactly under our feet, being the inferior pole of our horizon, and the zenith or superior pole of the horizon of our antipodes. The pole of any circle is a point on the surface of the globe 90° distant from every part of the circle. Thus the poles of the world are 90° from every part of the equator; the poles of the ecliptic (on the celestial globe) are 90° from every part of the ecliptic, and 23° 28′ from the poles of the equinoctial; consequently they are situated in the arctic and antarctic circles. Every circle on the globe, whether real or imaginary, has two poles diametrically opposite to each other. The equinoctial points are Aries and Libra, where the ecliptic cuts the equinoctial. The point Aries is called the *vernal equinox*, and the point Libra the *autumnal equinox*. When the sun is in either of these points the days and nights on every part of the globe are equal to each other. The solstitial points are Cancer and Capricorn. When the sun enters Cancer it is the longest day to all the inhabitants on the north side of the equator, and the shortest day to those on the south side. When the sun enters Capricorn it is the shortest day to those who live in north latitude, and the longest day to those who live in south latitude. The latitude of a place on the terrestrial globe, or its distance from the equator in degrees, minutes, or geographical miles, &c., is reckoned on the brass meridian from the equator towards the north or south pole. The quadrant of altitude is a thin piece of brass divided upwards from 0 to 90°, downward from 0 to 18°; when used it is generally screwed to the brass meridian. The upper divisions determine the distances of places on the earth, the distances of the celestial bodies, their latitudes, &c.; and the lower divisions are applied to finding the beginning, the end, and duration of twilight. The longitude of a place on the terrestrial globe is the distance of the meridian of that place from the first meridian, reckoned in degrees and parts of a degree, on the equator. Longitude is either eastward or westward, according as a place is to the east or west of the first meridian. No place can have more than 180°, or half the circumference of the globe. Hour circles are the same as meridians. They are drawn through every 15° of the equator, each answering to an hour. The brass meridian and these circles always correspond. A number of *problems* or questions, many of them more curious than useful, may be solved by means of a terrestrial globe. Among the most important are such as to find the latitude and longitude of a place, the distance between two places, the difference of time between two places, the time of the sun's rising and setting for a given day at a given place, &c. The shortest distance between two places is that portion of a great circle which passes through both that lies between them. This arc may be measured by a pair of compasses, which are then applied to the equator or the brass meridian, in order to obtain the number of degrees comprised between them. Degrees of latitude may be converted into English miles by multiplying them by 69·12, the number of miles in a degree of latitude. The difference of time between two places is shown roughly by the hour circles. To find what time it is at Berlin, for instance, when it is twelve o'clock at London, bring London to the general meridian, set the index at 12, then turn the globe till Berlin come to the meridian, when the index will point to the hour corresponding to twelve at London. To find the latitude turn the globe till the place comes to the graduated edge of the brazen meridian, and the degree on the meridian with which the place corresponds is the latitude north or south, as it may be, of the equator. To find the longitude of any place, turn the globe till the place comes to the brazen meridian, and the degree on the equator intersected by the brazen meridian shows the longitude.

GLOBULIN, a name given to several albuminoid substances, the application varying from time to time with the progress of knowledge respecting them. It was given by Berzelius to the albuminoid body obtained from the globules of blood, and was afterwards identified with that obtained from the crystalline lens of the eye, which was termed *crystalline*. The bodies now known as globulins are albuminoids, distinguished from the albumins by being insoluble in water, but agreeing with them in being soluble in neutral saline solutions, dilute acids, and dilute alkalis. They agree with the group of derived albumins (syntonin, casein, acid albumin, and alkali albumin) in their insolubility in water and their solubility in dilute acids and alkalis, but differ in being dissolved by neutral saline solutions. The group of globulins comprises *myosin*, *serum globulin*, *fibrinogen*, and *vitellin*. The first of these is white when wet and yellow and horny when dry, and is changed by solution in dilute acids into syntonin. It occurs in the substance of the voluntary muscles. Serum globulin, also known as *paraglobulin*, is obtained from blood serum, by the action of carbon dioxide, in the form of minute, colourless granules. Dilute acids convert it into a derived albumin. Fibrinogen is found in blood plasma, from which it may be obtained by the action of water and carbon dioxide. The clotting of blood is accompanied by the transformation of fibrinogen into fibrin, another albuminoid. Vitellin is left after yolk of egg has been treated with water, alcohol, and ether.

GLOCKNER, or Gross Glockner, a mountain of Austria, on the frontiers of the Tyrol, Carinthia, and Salzburg. It is the culminating point of the Noric Alps, is 12,455 feet in height, and is composed of schistous and calcareous rocks, but appears to have a nucleus of granite. The ascent has been repeatedly accomplished, but is difficult, and not without danger.

GLOGAU, or Gross-Glogau, a Prussian town and fortress of the second class, in Silesia, in the government of Liegnitz, not far from the Oder. It has manufactures of sugar, starch, syrup, earthenware, iron, machinery, &c., and a brisk inland trade. It has several churches, one of them formerly a cathedral; town-hall; post-office; theatre; a Lutheran and a Catholic gymnasium, &c. The last Duke of Glogau died in 1476, and the principality fell to the crown of Bohemia. Frederick the Great took Glogau in 1741, and strengthened its fortifications. After the battle of Jena the French occupied it until 1814, when it was delivered up to the Prussians. Pop. (1895), 21,836; (1900), 22,147.

GLOMMEN, the largest river in Norway, issues from Lake Oresund, about 2417 feet above the sea-level, in the south-east of South Trondhjem, flows S.S.W. to Mount Tronen, then S.S.E. to the fortress of Kongsvingar, where it turns W.N.W., then S.S.W., and after a course of above 370 miles falls by two mouths into the Skagerrack at Frederikstadt. In its course it forms several lakes and beautiful cascades. Its most important tributaries are the Rena on the left, and the Vormen on the right.

GLORIA IN EXCELSIS DEO ('Glory to God in the highest'), and Gloria Patri ('Glory to the Father'), the initial words, used as titles, of the greater and lesser doxologies respectively. The former is also known as the angelic hymn because it opens with the words sung by the angels at the nativity. See Doxology.

GLORIOSA, a genus of plants, natives of India and Africa, belonging to the natural order Liliaceæ. The best-known species is *G. superba*, often cultivated in hothouses for its fine flowers. The root is perennial and tuberous; the stem herbaceous, weak, from 6 to 10 feet high, bearing two opposite lateral branches; the leaves alternate, terminating in tendrils; the flowers remarkably elegant, of a beautiful red and yellow colour, provided with six long lanceolate undulated petals, which are entirely reflexed. It is a tender stove plant, and great heat is necessary to produce the flowers. During winter the roots should be kept in a warm place, packed in dry sand, without water. The genus is now often named *Methonica*.

GLOSS, in criticism, the explanation of verbal difficulties in a literary work, written at the passages to which they refer. The words which are commonly the subject of these explanations are those taken without modification from a foreign language, provincialisms, obsolete and technical words, or such as are used by the author in some exceptional signification. The earliest glosses, as those in Greek, Latin, and Hebrew manuscripts, were interlinear; they were afterwards placed in the margin, and extended finally in some instances to a sort of running commentary on an entire book.

GLOSSOP, a municipal borough and market town of England, in the county of Derby, a station on the Great Central Railway, 30 miles west by north of Sheffield. It contains several churches and schools, public reading-rooms, a hospital, and public baths, the two latter presented to the town, &c. The district is the principal seat of the Derbyshire cotton manufacture, and there are also paper-mills, iron-foundries, dyeing, bleaching, and print works, &c. There are two annual fairs. It was incorporated in 1866. Pop. (1891), 22,416; (1901), 21,526.

GLOTTIS. See Larynx.

GLOUCESTER, or Gloucestershire, a maritime county of England, bounded S. by Wilts and Somerset; E. by Oxford; N. and N.W. by Warwick, Worcester, and Hereford; W. by Monmouth and the Severn; length, south-west to north-east, about 64 miles; greatest breadth, about 30 miles; area, 796,734 acres, of which 750,000 acres are arable, meadow, and pasture. The county is naturally divided into three distinct districts, the Hill or Cotswold, the Vale, and the Forest Districts. The first comprises the hilly country, stretching from Chipping Camden on the north to Bath on the south; the second, or Vale District, comprehends the whole of the lowlands from Stratford-upon-Avon to Bristol, and includes the Vales of Evesham, Gloucester, and Berkeley; the third, or Forest district, includes the parishes on the west side of the Severn up to Gloucester, and afterwards on the west side of the Leden to the Wye. The hill district is in general bleak and bare; but includes many beautiful dales and much picturesque scenery. It lies on the limestone and clay of the oolitic formation. Much of the soil in the vales is extremely fertile, and the climate mild. The geology of the vale district is exceedingly varied, including all the formations between the upper Silurian and oolite. A large portion of the district lies on the blue lias; and is in pasture generally of poor quality. The forest district derives its name from the royal Forest of Dean, formerly very extensive, but now much reduced, chiefly by the exercise of the right of mining for coal by the free foresters. Great part of it, however, is still crown property, under the care of a lord-warden. The principal rivers in Gloucestershire are the Severn, with its affluents, the Wye, the Leden, and Lower and Upper Avon; and the Isis or Thames, with its affluents the Colne, Churnet, and Windrush. The Severn is famous for its salmon, which, under protective legislation, have largely increased. Iron and coal are found in

the Forest of Dean; the former is not extensively wrought, but the collieries employ a large number of hands. Coal is also found and extensively worked in the south part of the county; and lead ore is found in various parts, but not in sufficient quantities to pay the expense of working. Limestone and freestone are also met with. Agriculture is in a flourishing state, especially in the vale districts of the county. Wheat, barley, oats, and beans are the crops principally cultivated. The latter are produced mostly on the clay soils of the vales. Gloucester is, however, much more of a dairy than an agricultural county, being remarkable for the richness and extent of its natural pastures, the most valuable of which lie along the banks of the Severn. The celebrated cheese, known as double and single Gloucester, is produced chiefly in the Vale of Berkeley. The native sheep of the Cotswold Hills are large, with coarse wool; but the breed is now largely intermixed with Leicesters and South Downs. In the vale and forest lands, and on the sides of the hills, there are numerous orchards, from the produce of which large quantities of cider are made. Gloucester is a considerable manufacturing county, and has been long famous for its fine broad-cloths. It is intersected by lines of the Midland and Great Western Railways. The county has five parliamentary divisions, with one member for each, namely Cirencester, Forest of Dean, Stroud, Tewkesbury, and Thornbury. It contains the parliamentary boroughs of Gloucester and Cheltenham. Pop. (1891), 599,974; (1901), 634,666.

GLOUCESTER, a city, municipal, county, and parliamentary borough, and river port of England, capital of the above county, in a vale on the east bank of the Severn, which here divides into two channels inclosing the Isle of Alney, 33 miles north by east of Bristol. It consists of four principal streets, diverging from the cross, and called Northgate, Southgate, Eastgate, and Westgate, from the ancient gates of the city, and of a number of smaller, all tolerably straight. In the main streets of the old city one sees the most venerable edifices jostled by buildings of the latest architectural design. The most remarkable public edifice is the cathedral, one of the noblest in England. It was originally the church of a Benedictine abbey, established in the beginning of the eleventh century. It is cruciform, 444 feet in length, 154 in breadth, and 85½ in height, with a tower 230 feet high. Having been built at different periods throughout several centuries, it exhibits a great variety of styles, the specimens of some of which, as here exhibited, are unrivalled. In the interior of the cathedral are many ancient and interesting monuments. Amongst them are those of Robert, son of William the Conqueror, who, together with his brother Richard, was interred here, and of Edward II., murdered in Berkeley Castle, the former carved in Irish oak, the latter of Purbeck marble. Other public buildings worthy of notice are several handsome old Established churches and Dissenting chapels; the shire hall, in classic style, recently enlarged and improved; the guildhall, to which in 1892 the municipal offices were removed from the old Tolsey, now demolished; the general post office; the county gaol; corn exchange; a capacious general market and a fine cattle-market; the municipal public baths; art, science, and technical schools; public library; bishop's palace; the new electric light station; custom-house, &c. The schools include the King's School, the Crypt Grammar School, Sir Thomas Rich's school for boys, the Girls' School at Mynd House, the High School for girls, besides many board and voluntary schools. There is also a well-supported literary and scientific association. One of the great English musical festivals is held at Gloucester, Worcester, and Hereford in turn. Among the benevolent institutions are the new infectious diseases hospital, the county infirmary and eye institution, the children's hospital, and three lunatic asylums. Gloucester has a tastefully-laid-out public park, with an adjacent spa. The town is well supplied with water from neighbouring reservoirs. The chief manufactory is a large work for railway carriages and waggons, and among other industries are engineering, match-making, the manufacture of preserves and confectionery, flour-milling, slate and marble working, cabinet-making, brewing, iron-founding, boat-building, &c. Gloucester has been an inland port for centuries, but it is only in quite modern times that it has become a place of importance in a commercial point of view, a result chiefly owing to the opening of the Gloucester and Berkeley ship canal in 1827, by which the exports and imports are now effected at the port itself, instead of being conveyed by barges up and down the Severn. It has also a considerable inland trade by canal and railway. Gloucester is a station on the Great Western and Midland railways. It is a place of high antiquity, and is said to have been in existence long previous to the Roman invasion; but was, at any rate, undoubtedly an important Roman military station known by the name of *Colonia Glevum*; it was an important town under the Saxons, by whom it was called *Gleawan Ceastre*. In the Civil War Gloucester declared for the parliament, and in consequence was besieged, unsuccessfully, by the royalists in 1643. Previous to 1885 Gloucester returned two members to Parliament, it now returns but one. Population in 1881, 36,542; in 1891, 39,444; in 1901, 47,944.

GLOUCESTER, a post-town and port of entry of Essex county, Massachusetts, United States of America, 28 miles N.N.E. of Boston, is situated on the south side of the peninsula of Cape Anne, and connected by railway with the principal cities in the state. It is beautifully situated and compactly built, and of late years has become a fashionable watering-place. It is an important fishing-town, and has a considerable foreign commerce. The harbour is one of the best on the coast, being accessible at all seasons for vessels of the largest class. In 1775 and 1814 the town successfully resisted attacks by English vessels. Pop. (1900), 26,121.

GLOVE-CLEANING. *Kid gloves* must be first slightly damped and gently stretched over a wooden hand of the appropriate size. Then clean with a sponge dipped in benzole (or benzine), recently rectified oil of turpentine, or camphine. As soon as they are dry remove them from the stretcher and expose them to a current of air until they cease to smell of the cleansing liquid. The smell of benzole passes off very quickly.—*Doeskin* and *wash-leather gloves* may be cleaned by stretching on the 'hand' and then rubbing in a mixture of finely-powdered fuller's-earth and alum; sweep this off with a brush and dust the gloves with a mixture of dry bran and whiting. When the gloves are very dirty wash them in lukewarm soft water with a little Castile or curd soap, ox-gall, or bran tea; then stretch them on wooden hands or pull them into shape without wringing them; next rub them with pipe-clay and yellow ochre mixed with ale or beer to the desired shade; dry carefully, dust off the superfluous powder, and smooth them with a hot iron.—Leather gloves may be dyed if desirable with any of the ordinary dyes applied to the surface, after the cleaning operation. The glove should be stretched on the hand, and a second and third coat applied after the first is dry. When the last is perfectly dry, rub off the

superfluous colour, smooth with a polished stick or piece of ivory, then go over the whole with a sponge dipped in white of egg.

GLOVER, RICHARD, an English poet, was the son of Richard Glover, a merchant of London, where he was born in 1712. He early displayed an attachment to the belles-lettres, and, when only sixteen, wrote some verses to the memory of Sir Isaac Newton, which obtained considerable attention. In 1737 he published the epic poem of Leonidas, which was favoured by the party in opposition to Sir Robert Walpole, headed by Frederick, prince of Wales. It abounds in noble sentiments, considerably varied by incident and description; but it wants interest, and is not sufficiently imaginative for lasting popularity. The Progress of Commerce followed in 1739; one of the objects of which was to rouse a spirit of national hostility against the Spaniards and the ministry—a purpose which was much more effectually answered by his celebrated ballad of Hosier's Ghost. In 1742 he was chosen by the London merchants to conduct an application to Parliament complaining of the neglect of trade; and the speech which he pronounced at the bar of the house was printed and much applauded. In 1753 his tragedy of Boadicea was performed at Drury-Lane Theatre with partial success. His Medea, imitated from Euripides and Seneca, in 1761, obtained greater attention. About this time, being chosen member of Parliament for Weymouth, he was esteemed by the mercantile interest as an active and able supporter. He died in November, 1785, leaving behind him another epic poem, forming a sequel to Leonidas, entitled the Athenaid, which was published in 1787, but attracted little attention. In 1813 appeared a diary or part of a diary written by him.

GLOVES, with respect to commerce, are distinguished into leather, silk, thread, cotton, worsted, &c. Leather gloves are made of the skin of the chamois, kid, goat, lamb, sheep, doe, elk, &c. The leather of gloves (unless for those of the strongest kind) is not tanned, properly speaking, but cured with alum, which renders it soft and pliable, and easy for the hands. Many of the so-called 'kid' gloves are not really made of the skins of kids, but of those of sheep and goats. Much leather of this kind is made in France. The gloves known as 'dogskin' gloves are also made from sheepskin leather. After the leather is properly prepared it is cut into pieces of the required size and folded over somewhat unequally, as the back must be larger than the front. Three cuts are then made through the doubled piece to produce the four fingers; an oblong hole is cut at the bending of the fold for the insertion of the thumb-piece. The first and fourth fingers are completed by gussets sewed only in their inner sides, while the second and third fingers require a gusset on each side to complete them. Besides these small diamond-shaped pieces are sewed in at the base of the fingers towards the palm of the hand. The stitching together of these pieces requires much care, as the junction must be made close to the edge of each piece, yet with sufficient hold to prevent the stitches from cutting through the material. The putting in of the thumb-piece requires special skill; badly-made gloves commonly give way at this part. The best woollen, thread, and silk gloves are made as above described by cutting out and sewing, but commoner gloves are made by knitting and weaving. The chief seat of the leather glove manufacture in England is at Worcester; they are also made to a considerable extent at Ludlow, Leominster, and Yeovil, besides Woodstock, where a superior doeskin glove is made bearing the name of the town. Large quantities of cotton gloves are manufactured at Nottingham and Leicester; and the greater part of the woollen gloves is made in Wales, Scotland, and the North of England. An immense number of gloves are made in France: they are distinguished for neatness and elegance, as the English for durability. Danish ladies' gloves are very famous.

We have reason to suppose that gloves were used by the Persians, as Xenophon, in the Cyropædia, mentions that on one occasion Cyrus went without them. The Greeks and Romans used them, but only for certain kinds of labour, as, for instance, in hedging. They were called *chirothecæ* and *manicæ*. *Manica* properly signifies the sleeve, which was sometimes united with a glove, or more probably was worn so long that it could be used as a mitten. During the middle ages gloves were at first considered as a mark of dignity; archbishops, &c., wore them. It was usual for a knight who had gained the favour of a lady to wear her glove in his helmet. Gloves play a conspicuous part in many national customs and usages, which originated in the age of chivalry. Throwing the glove down before a person amounted to a challenge to single combat, which was accepted by the person before whom it was thrown picking up the glove and throwing down his own to be taken up by the challenger. The delivery of a glove was also a symbol of investiture. The Council of Aix, in the reign of Louis le Débonnaire, prohibited by an edict the monks wearing any gloves but of sheep skin. But all the powers of the councils, popes, and cardinals could not accomplish this object, and glove-wearing by the monks and other ecclesiastics is a subject of frequent complaint by ascetics. The Council of Poictiers confined the use of 'sandals, rings, and gloves to bishops.' At the coronation of the kings of France the ceremony of blessing the glove was constantly observed, as was that of the champion throwing the glove in the ring at the coronation of the King of England. At the coronation of George II. an unknown gentleman took up the glove as the champion of the Pretender, accepting thereby the challenge of the champion in defence of the right of the house of Hanover to the throne. The judges in England used to be prohibited wearing gloves on the bench; and it was only in case of a maiden assize that the sheriffs were allowed to present a judge with a pair of gloves. The custom of presenting gloves in such circumstances still obtains in England and also in Scotland. It was an old English gambol to win a pair of gloves by kissing a lady who was caught asleep or sitting on the table in company; and it was an ancient custom in France and Germany to forfeit the gloves if a person entered the stables of a prince or peer without previously pulling them off. These gloves were to be redeemed by a fee to the grooms. In Germany the men that carry the bier at a funeral receive a pair of gloves and a lemon; the clergyman also receives a pair of gloves at a wedding ceremony. See GLOVE-CLEANING.

GLOW-WORM. This is the female of one of the species of *Lampyris*. The light is most frequently observable early in the summer, when the animal is in motion, and is of a lambent electric greenish colour. It can be withdrawn or displayed at pleasure, by contracting or unfolding the body. This extraordinary provision of nature is for the purpose of attracting the male. The glow-worm is apterous, or without wings. The female, which is larger than the male, is fully ½ inch in length, of a blackish colour, the legs dusky red, and the thorax and abdomen margined with that colour. The male possesses elytra which cover wings longer than the body. The head and antennæ are black, the former concealed by the broad plate of the thorax. The four last rings of the abdomen, which emit the light, are not so bright in the male as in the female, and are nearly destitute of that

luminous quality which renders her so remarkable. The light-emitting segments preserve their peculiar property for some time after being separated from the rest of the body, and manifest it even in vacuo, or when immersed in gases which are not supporters of combustion.

GLUCHOV, or GLOUKHOV, a town of Russia in Europe, in the government of, and 148 miles east by north from Tchernigov, near the right bank of the Verbovka. It is surrounded with an earthen wall; contains several churches and convents, has extensive cloth manufactories, and a considerable trade in grain and brandy. In the vicinity porcelain clay is obtained and sent to the imperial manufactory at St. Petersburg. Pop. (1897), 14,856.

GLUCIC (or GLUCINIC) ACID. When grape sugar is kept in contact with lime-water, the solution gradually becomes neutral, and then contains glucate of calcium. By conversion into the lead salt, and decomposition with sulphuretted hydrogen, filtering and evaporating, the acid is got as a colourless amorphous body, soluble in water and in alcohol, and having an acid taste. By prolonged heating with water or dilute acids, it undergoes further decomposition and becomes brown. The salts of this acid are for the most part soluble in water.

GLUCINUM, or BERYLLIUM (Be=9), one of the less common chemical elements, occurring in only a few minerals, of which the more important are the beryl or emerald [$(BeO)_3Al_2O_3$, $6SiO_2$] (which see), the chrysoberyl ($BeOAl_2O_3$) (which see), phenakite ($2BeO$, SiO_2) (which see), and euclase [$(BeO)_3Al_2O_3$ $2SiO_2$] (which see). The oxide of the metal or glucina was first ascertained to be a separate earth by Vauquelin, who in 1798 obtained it from beryl, distinguished it from alumina (of which earth the beryl had hitherto been believed to be composed) by its incapacity of forming an alum, and who afterwards got it from the emerald. The first name given to it was *glucina* (Gr. *glykys*, sweet), because its salts have a sweet taste; subsequently it received the name of *beryllium*. Metallic glucinum was first obtained in 1828 by Wöhler and Bussy; and by different processes by Becquerel and by Debray. Glucina is extracted from the above-mentioned minerals by fusion with an alkaline carbonate, evaporation to dryness with hydrochloric acid to remove silica, and the separation of the glucina from the alumina, &c., is effected by adding to the cold solution ammonia, which throws down iron, alumina, and glucina, and then, on digesting this precipitate with excess of carbonate of ammonium, the glucina dissolves. On boiling the solution the earth precipitates. The metal is got by first preparing the anhydrous chloride of glucinum by passing a current of dry chlorine over an intimate mixture of glucina and charcoal heated to redness. When this chloride is heated with metallic sodium, or when the vapour of the chloride is passed over heated sodium, chloride of sodium is formed, and glucinum liberated. The metal is got in a compact state by further fusion with common salt. It appears to be white, and of specific gravity 2·1. It is malleable, moderately fusible, it combines with oxygen, but without catching fire, combines readily with chlorine and with sulphur, when heated in its vapour. It has no action on water, is dissolved by hydrochloric and sulphuric, but with difficulty by nitric acid, and is soluble in potash. Beryllium forms a large number of different salts, all belonging to one class. Concerning the atomic weight of this element much doubt existed, it being regarded by some chemists as a triad, by others as a dyad. The latter view is now known to be correct. Its atomic weight is 9, not 13·5, and it forms salts on the type of those of magnesium not in any way analogous to those of aluminium. Of these the more important are: the *chloride*, obtained anhydrous by the process above described, and forming a cake composed of silky crystals, which fuse readily and volatilize, are deliquescent and dissolve in water with formation of a hydrate; the hydrated chloride can also be obtained as a crystalline mass by dissolving the metal or oxide in hydrochloric acid; the *oxide*, obtained by a variety of processes, is a white light powder, insoluble in water. When heated to a very high temperature it does not fuse—it volatilizes; it is not rendered harder by the process, but rather less soluble in acids. The *hydrated* oxide is a white precipitate resembling alumina, but distinguished by its solubility in certain salts, especially in carbonate of ammonia. The remaining salts, the nitrate, sulphate, phosphate, and others, are some of them soluble in water, others insoluble. They are of no general interest. Neither glucinum nor any of its compounds is employed for any purpose.

GLUCK, CHRISTOPH WILIBALD, RITTER VON. This musical composer, to whom the opera is indebted for its splendour and dramatic perfection, sprang from a respectable family in the upper palatinate of Bavaria, where he was born in the village of Weidenwang, on the Bohemian border, on July 2nd, 1714. His father was master of the chase to the prince Lobkowitz, and treated Christoph and his brothers harshly, making them follow him barefooted, carrying part of his hunting gear, to make them hardy, as he phrased it. Christoph was sent from his twelfth to his eighteenth year to the Jesuit school at Komotow. The boy had a good knowledge of singing and playing bowed instruments, and in the school of the Jesuits his musical faculties were especially cultivated. He became a chorister in the principal church of the place, and acquired some skill on the harpsichord and organ. At eighteen years of age he went to Prague to enter the university, but his studies there were not of long continuance, for with the increase of his father's family the pecuniary aid from home became less and less, and the student had to betake himself to music for his subsistence. He gave lessons in singing and upon the violoncello, sang and played in several of the principal churches for a miserably small salary, and during vacations performed in the surrounding villages, being sometimes paid in one with eggs, which in another he exchanged for bread. By degrees the youth attracted the attention of several Bohemian nobles, foremost among whom was Prince Lobkowitz. This prince opened his house to him when the young man went to Vienna to pursue his musical studies, and at the age of twenty-two a salary was given him which at length enabled him to enter upon the study of the fundamental principles of musical science. In the Austrian capital he heard for the first time the works of Fux, Caldara, the brothers Conti, and other great composers adequately performed, works which astonished and delighted him, and filled him with an ambition to be able at some time to compose a genuine work of art. The Lombardian prince di Melzi, who heard him sing and play in the *soirées* given in the Lobkowitz Palace, was so delighted with him, that he appointed him chamber musician, and took him to Milan, where he studied under Giovanni Battista Sammartini, at that time a famous organist and composer. In 1740 the young German had given so many proofs of his talent in composition that he was employed to compose an opera for the court theatre of Milan. The text chosen for him was the Artaxerxes of Metastasio. The young artist sat down to his task with a feeling of the hollowness and insufficiency of the then recognized forms of opera composition, where all was sac-

riced to tickle the ear or allow a favourite singer an opportunity for showing off, and where real musical and dramatic expression was the last thing thought of. He ventured from the beaten track to some extent, making expression his great object all throughout the piece, except in one air written to hit the prevailing taste. At the rehearsals the virtuosi received the piece with shrugs, smiles, and jokes upon the young German composer, but the solitary air had their rapturous applause, it was in the strictest style of the day, and allowed the singer plenty of room for display, and with one consent it was attributed to Sammartini. The first public performance came off with appropriate scenery and decoration; the house was crowded; the interest rose with every number of the opera until the brilliant air was reached, which was received so coldly that Gluck cut it out and substituted another. The success was complete; the public taste had proved healthier than the critics', and the composer was called from city to city of Italy to direct his Artaserse. In 1742 he wrote Demofoonte for Milan; Demetrio and Ipermnestra for Venice; in 1743 Artamene for Cremona, and Siface for Milan; in 1744 Fedra for the same theatre; and in 1745 Allessandro nell' Indie for Turin. His fame had now become European, and he was invited by Lord Middlesex to come to England, to compose for the theatre in the Haymarket. On 7th January, 1746, that theatre was opened with La Caduta de' Giganti, written in honour of, and produced before the Duke of Cumberland, music by Gluck. The piece did not take, owing, as Burney says, to inadequate representation. On Gluck complaining of the ill-success of the opera to Handel, then resident in London, the old veteran, on being shown the score, said: 'You have simply taken too much trouble with your opera, and it will do you no good; the English like something striking, and you must think of giving the big drum a fair opportunity.' This is said to have induced Gluck to strengthen his choruses with trombones, in most cases with excellent results. In London Gluck became deeply impressed with the majestic character of Handel's airs and choruses, and with the simple but natural dramatic style of Dr. Arne. To this must be added that he had particularly noted the effective and dramatic use of chorus and ballad by Rameau in his operas, which Gluck had heard in Paris, where he had remained some time while on his way to England, and now before leaving London he had a notable proof that the principles which partially influenced him in the composition of his first opera —that of expressing first of all the passion of the moment as depicted by the poet, were correct. He had been commissioned by the London managers to prepare a *pasticcio*, Pirame e Tisbe, that is, to adapt music to this libretto from other operas. In doing this he selected from his own works such pieces only as had been most rapturously applauded, and adapted these with all the skill and science of which he was master. To his surprise he found that with a new text, new actions, and new situations, the music seemed to have lost all its power. From this he concluded that all genuine operatic music, having a higher aim than merely to tickle the ear, is necessarily of a character which unfits it for any other text and situation than that to which it owes its origin. From this fundamental principle of dramatic composition he gradually worked out a system upon which he was to base the success of a series of imperishable operatic compositions. The leading points of this system are: 1st, that dramatic music can only reach its highest power and beauty when joined to a text, simple, truly poetic, and exhibiting natural and definite emotions and passions, with the closest fidelity to nature; 2d, that music may be made the language of emotion, capable of expressing the various feelings of the heart; 3d, that the music must follow with all possible exactness the rhythm and accent of the words; 4th, that in accompaniments the instruments must be used to strengthen the expression of the vocal parts by their peculiar characters, or to heighten the general dramatic effect by employing them in contrast to the voice, as the text or dramatic situation might demand. From these principles it followed that the brilliant arias which were then considered the highest efforts of the art, though in fact unsurpassable as means of sensuous gratification to the ear, so perfect were many of them in form and exquisite melody, could never deeply touch the soul, nor raise any lasting emotion; as he himself said, on an occasion when an aria of this kind was praised: 'Yes, it is very pretty, but it doesn't draw blood!'

In the end of 1746 he left London, and received a lucrative appointment as member of the electoral orchestra at Dresden, a position he did not retain long. The death of his father in 1747 called him to Bohemia, to settle a small estate left to him, which done he returned to Vienna, a city he made henceforth his home, only leaving it when called to Paris or Italy to superintend the production of new works. In the Austrian capital he became a great favourite, not on account of his musical abilities only, but owing in great measure to his social qualities. In 1750 he went to Rome to direct the new opera Telemacco, which he had composed for the Argentina Theatre, and on his return to Vienna he married a former music pupil, the daughter of a wealthy capitalist named Pargin. Between 1751 and 1762 he composed several operas, Clemenza di Tito, Le Cinese, Il Trionfo di Camillo, Antigono, which gained him from the pope the order of Knight of the Golden Spur, La Danza, &c., besides a great number of airs and other pieces for a series of French operettas and vaudevilles, performed at Vienna. The Trionfo di Clelia (1762) was the last of his operas in his first style. However well pleased the public was with his music, he was not so. He felt himself continually cramped by the character of the libretti of Metastasio, who had hitherto furnished him with texts, which were rather lyrical dramatic poems than genuine dramas. The composer at last found a poet in the person of Raniero Calzabigi, who sympathized with him in his ideas, and the result of their co-operation was the Orfeo ed Euridice, performed publicly for the first time 5th October, 1762. Surprised and astonished, with their hearts strangely moved, the audience left the house. The novelty of the style was soon forgotten, and the music became extremely popular in Vienna; now, after more than a century has closed, the opera is still a stock piece in Berlin, having lost none of its freshness and pathos. Various works of lighter character fill up the interval between this year and 1766, when his second great opera of Alceste was produced, which raised public feeling to the point of enthusiasm. In his dedication of this work to the Grand-duke Leopold of Tuscany he enunciates the views of operatic composition which we have already briefly stated. In 1769 appeared his Paride ed Elena, which has succeeded in retaining favour only with musicians. Gluck now became convinced that his system must be tested on a wider field, and believed that the Royal Opera in Paris, from the superiority of its singers as vocalists and actors, from the number of its chorus singers, the completeness of its orchestra, offered all a composer could demand. A Frenchman of culture and genius, Bailly du Rollet, adapted Racine's Iphigénie en Aulide for musical treatment, and after a considerable amount

of opposition from the musical critics of the old Italian and French school, at that time represented in Paris by Piccini, the piece was brought out 19th April, 1774. The intensest excitement prevailed; all Paris took sides, and for a long time the Gluckists and Piccinists contended with the same bitterness as did formerly the Jansenists and Jesuits, and in our own day Wagner and his opponents. Rousseau, Arnaud, and Suard sided with Gluck, while Laharpe and Marmontel went over to Piccini. It is but fair to say that the two chiefs laid aside all the bitterness of rivalry, and became reconciled long before their disciples ceased to fight. The victory remained with the Gluckists. Shortly after the production of the Iphigénie, the Orfeo was adapted for and put on the French stage, and was followed by the Armide in 1777, by the Iphigénie en Tauride in 1779, his last important work, and by many considered his greatest. It ends the series of works which directed the operatic genius of Méhul and Cherubini in France, and of Mozart, Beethoven, and Wagner in Germany. Gluck died in Vienna from a stroke of apoplexy, 15th November, 1787.

GLÜCKSTADT, a town of Prussia, in Holstein, on the right bank of the Elbe, at the junction of the Rhin, 28 miles N.W. Hamburg; pop. 6214. It had fortifications, which enabled it to withstand the attacks of Tilly in 1628, but were dismantled in 1814. The inhabitants are largely concerned in the Greenland whale-fishery. The harbour is not commodious.

GLUCOSE. This is the name of a class of substances of which common glucose or grape-sugar is the best known. Two varieties of glucose are obtained from grapes, honey, and other sources, one turning a ray of polarized light to the right, and therefore called *dextro-glucose* or *dextrose*, the other to the left, and therefore called *lævulose*. The other varieties are *galactose* (which see); *eucalyn* (which see), got from Australian manna; *inosite* (which see); *sorbin* (which see); and *arabinose*, got from gum-arabic by the action of dilute sulphuric acid. These varieties yield different decomposition products by the action of acids.

Dextrose, grape, fruit, or diabetic sugar, seems to have been recognized as a distinct species of sugar by Glauber and others of the older chemists, afterwards more precisely by Lowitz in 1792, who distinguished it on account of the difficulty of getting it crystallized, and since then it has been subjected to minute investigation, so that its composition and characters are now very well known. Dextrose is the chief sugar in fruits, and especially in grapes; but it is always accompanied by a certain amount of cane-sugar or saccharose and lævulose. It forms the main part of the crystalline granules in honey; it is met with normally in the animal economy in the chyle, blood, lymph, muscle, liver, egg, and, according to some, in urine; and also pathologically in large quantity in the same substances; in diabetes mellitus it is present in the urine, sometimes to a very large extent, and is one of the characteristics of that disease. The origin of this sugar in animals is to be ascribed partly to the transformation of the starchy matter of the food, partly also to the transformation of parts of the system by the vital process. Dextrose can be extracted either from its natural sources, or it can be prepared by the action of acids upon cane-sugar, starch, cellulose, and other parts of plants. Thus it is got from the juice of grapes by neutralizing the acid, evaporating and purifying the liquor, and allowing it to stand, when the dextrose deposits. From honey it is got by repeated extraction of the lævulose by means of spirit, and then dissolving the residue in water and crystallizing. From diabetic urine it can be got by simply evaporating to crystallization, and then purifying the pressed crystals by alcohol; or by precipitating the alcoholic extract with lead acetate, decomposing this precipitate, dissolving the sugar in water, and crystallizing. Pure dextrose crystallizes in opaque white masses from water, but in fine needles from alcohol. Its composition is $C_6H_{12}O_6$. It requires about $1\frac{1}{2}$ times its weight of cold water for solution, but is abundantly soluble in hot water. It is moderately soluble in alcohol, but less so than cane-sugar. Its solutions have a sweet taste. When heated it becomes brown, swells up, gives off water, and caramel (which see) is formed. In several other respects it resembles cane-sugar, though it is distinguished from it by some characteristic reactions. Thus it dissolves in cold oil of vitriol without change of colour, whereas cane-sugar is quite decomposed, and is transformed into a black mass. It also reduces certain salts of bismuth and of copper, and by these reactions very minute quantities of it can be detected in presence of cane-sugar and of other substances. Indeed one of the best methods of estimating the amount of dextrose in a solution is by the amount of cupric tartrate that it can reduce to the state of cuprous oxide. Dextrose combines with a variety of substances: with water, to form different hydrates; with metallic oxides, to form compounds called *glucosates;* with alkaline salts, of which the most remarkable is the compound with common salt. This substance frequently separates from diabetic urine when evaporated. It is soluble in water, and can be got in very large transparent crystals. Dextrose does not combine direct with organic acids, but it reacts with them, forming bodies analogous to ethers. Similar compounds occur naturally in plants, and are called *glucosides* (which see); while those which have been formed artificially, and which differ from the natural compounds, are called *saccharides* (which see). Dextrose is capable of undergoing different kinds of fermentation. By yeast it is converted into alcohol, with liberation of carbonic acid; and this method has been used for estimating the quantity of dextrose in a mixture. Commercially glucose is prepared from starch (potato or maize), rice, sago, &c. It is used in making confectionery, preserves, jellies, table syrups, as a substitute for malt in brewing, &c.

GLUCOSIDES, a large class of substances occurring in plants, which are distinguished by decomposing under the influence of ferments, acids, and alkalies into sugar and usually one other substance the nature of which differs with different plants. The composition of the glucosides varies; sometimes nitrogen is present, but in general the compound consists only of carbon, hydrogen, and oxygen. Their constitution is practically unknown; they have never been formed synthetically; only a few seem to partake of the nature of compound ethers (see GLUCOSE). When decomposed by the agents above mentioned they assimilate water, and usually yield grape-sugar or dextrose, but some glucosides furnish other kinds of sugar. Of these naturally occurring compounds may be mentioned *æsculin; colocynthin*, which yields sugar and *colocynthein; convallarin; convolvulin; crocin; daphnin; datiscin; digitalin; euxanthic acid; fraxin; gallotannic acid* or *tannin; glycyrrhizin; jalappin; phloridzin; populin; quercitrin; salicin; scammony;* and *xanthorhamnin*. The following contain nitrogen:—*amygdalin; chitin; gelatin* or isinglass, which when boiled for a long time with dilute sulphuric acid decomposes and yields a sugar; *solanin;* and *myronic acid*, in which sulphur is also present. The majority of these bodies are described under their respective heads.

GLUE. This substance, so much used as a cement, is obtained from the different gelatigenous tissues of

animals, the quality depending on the material employed and the process of extraction. The best quality is obtained from the clippings and parings of ox-hides, the older skins being preferred; but large quantities are also got from the skins of common animals, sheep, calves, cows, hares, dogs, cats, &c., from the refuse of tanneries and tawing works, from old gloves, from sinews, tendons, and other offal of animal origin. The only material which is not suitable is tanned leather, for in that the gelatinous matter has been rendered insoluble. The first operation consists in treating the raw material with milk of lime, or dilute alkali, to remove fat, blood, and flesh. The mass is then well washed with water, and exposed to the air, and thereafter the material is transferred to the boiler, where it is subjected to gentle ebullition over a fire, or by means of steam. A great deal of the success of the operation depends upon the boiling, and upon the gradual withdrawal of the gelatinous solution as it is formed. For this purpose the boiler or caldron is provided with a false bottom perforated, through which the solution passes, and then by a pipe is run off into the concentrating pans, which are of wood lined with lead. The strength of the fluid is estimated by taking out a little of it from time to time and observing whether or not it solidifies on cooling. When it is duly concentrated, and has cooled somewhat, it is run into slightly conical wooden or metallic moulds, with previous filtration if necessary, and when it has acquired a certain degree of consistence, the jelly is turned out and cut into cakes. In the soft damp state it constitutes size. The next operation consists in drying the cakes. This is effected by laying them on nets mounted on frames, and exposing them to the air and the sun, which is better, though more hazardous, than drying the glue in a stove or oven. The best glue has a rich yellowish-brown colour; is uniformly translucent, clear, hard, glossy; is brittle, yielding a bright, conchoidal surface. It does not turn moist in the air; is not affected even when kept for a considerable time in cold water, but dissolves on heating, the solution gelatinizing on cooling, though there be not more than a hundredth part of glue present. Different methods of testing glue have been devised; the most direct and obvious method is to ascertain the force required to separate two objects glued together; another depends on the amount of water taken up by the glue at 60° F.; while a third is based on precipitation with tannin. Good glue may be kept without undergoing any decided change; but when acted on by various chemical reagents, it yields a numerous series of decomposition products, or alters its properties. When repeatedly warmed with water and cooled it loses its power of gelatinizing. When a solution is mixed with acetic or nitric acid it remains liquid, but still retains its power of cementing; in this state it is called *liquid glue*. The mixture called *elastic glue* is prepared by melting glue in water, adding the same weight of glycerin as of glue, thoroughly incorporating the materials, and evaporating. The soft mass can then be moulded for the required purpose. Elastic glue is used for making electrotype moulds, inking rollers for printing, &c. A solution of glue in water is precipitated by alcohol, by chlorine gas, and by tannin. When treated with sulphuric acid alone glue ultimately yields glycocine, and from this reaction gelatine has been described as a glucoside. When treated with oxidizing agents, for instance with oxide of manganese and sulphuric acid, it yields a large number of products, such as leucine, tyrosine, formic, acetic, valerianic, and other acids. Glue is not unfrequently mixed with a variety of substances to increase its adhesion. Lime, white-lead, zinc-white, &c., are employed for this purpose.

Another kind of glue, known as *bone glue*, is prepared from bones, which for the best qualities must be quite fresh when treated. *Fish glue* is made by boiling the heads, fins, and tails of fish at 110° C. *Isinglass* is a kind of glue.

Method of preparing and using glue.—Set a quart of water on the fire, then put in about ½ lb. of good glue, and boil them gently together till the glue be entirely dissolved, and of a due consistence. When glue is to be used it must be made thoroughly hot; after which, with a brush dipped in it, besmear the faces of the joints as thick as possible; then, clapping them together, slide or rub them lengthwise one upon another two or three times, to settle them close, and so let them stand till they are dry and firm.

GLUTEN, a vegetable compound, procured by repeatedly washing wheat flour in a large quantity of water, by which means the flour is separated into vegetable albumin, which dissolves; starch, which remains in suspension; and gluten, which is left behind in a very tenacious, ductile, somewhat elastic state, and possessed of a brownish-gray colour. It has scarcely any taste, and is insoluble in water, but is taken up by acids and alkalies. The acid solution is precipitated by an alkali, and, reciprocally, the alkaline solution by an acid. Dried by a gentle heat it contracts its volume, and becomes hard and brittle; heated to a higher temperature it shrivels up, crackles, and evolves the same decomposition products as albumin itself, or of animal matter in general. Gluten is present in the flour of wheat to the extent of from 11 to 13 per cent; it is present in much smaller quantity in that of barley, rye, oats, pease, and beans. It is to the presence of gluten that wheat flour owes its property of forming a tenacious paste with water, to which cause is due the formation of light spongy bread. The carbonic acid, which is disengaged during the fermentation of the dough, being detained by the viscid gluten, distends the whole mass, and thus produces the rising of the bread. The wheat of warm climates is richer in gluten than that of colder regions. Gluten consists of two distinct principles, to one of which has been applied the name of *gliadine*, from Gr. *glia*, glue, and to the other that of *zymome*, from *zymē*, a ferment. To obtain these principles the gluten is boiled repeatedly in alcohol, which dissolves the gliadine, and leaves the zymome in a pure state. The soluble part again is said to consist of two substances, mucin and gliadin proper. On mixing the powder of guaiacum with the latter substance a beautiful blue colour instantly appears; and the same phenomenon ensues, though less rapidly, when it is kneaded with gluten, or the flour of good wheat moistened with water. With bad flour, the gluten of which has suffered decomposition, the blue tint is scarcely visible. The intensity of the colour thus produced is entirely dependent on the relative quantity of zymome contained in the flour; and since the quantity of zymome is proportional to the quantity of gluten, the proportion of the latter, and therefore the quality of the flour, is tested by the action of the guaiacum. The whole character and constitution of gluten require still much investigation, as different observers do not agree in some of their results.

GLUTTON (*Gulo*). This genus of carnivorous quadrupeds is distinguished by the head being but moderately elongated, and the body long in proportion to its height from the ground. The ears are rounded and very short. There is a simple fold of the skin below the tail, instead of the pouch observable in the badger, to which animal it bears some resemblance. It may, in fact, be considered as intermediate between the true plantigrade and digitigrade animals. Desmarest describes four species; one of which, the *G. borealis*, Nils., or wolverene, is an

inhabitant of the northern parts of America (*G. luscus*, Sabine). The wolverene is about 28 inches in length from the tip of the nose to the origin of the tail, which latter is about 8 inches, if the hair at the extremity be included, which is from 3 to 4 inches long. The whole body is covered with very long and thick hair, which varies in colour according to the season or other circumstances. Its summer coat is generally as follows:—Face blackish as high as the eyebrows, and between these and the ears whitish or brownish; ears covered with coarse hairs; the lower jaw and the inside of the fore-legs spotted with white; upper part of the back, thighs, and under part of the belly, brown or brownish black; sides, chestnut colour.—Its fur is of considerable value, and is much used in the northern parts of Asia, of which the wolverene is also a native, for making and ornamenting robes. The animal, however, does not breed in sufficient numbers to furnish any great collection to the fur traders. It is very voracious, but at the same time slow and heavy in its motions, though it is remarkably acute in its sight and hearing. It is amazingly powerful, and an overmatch for any animal of its own size. It makes a strong resistance when attacked. If it can lay hold of it, it will tear the stock from a gun, and pull the traps in which it is caught to pieces. It has been stated by persons who are familiar with its habits, that it will lurk on a tree, and drop on a deer passing underneath, and fasten on it, drinking the blood, till the unfortunate animal dies from exhaustion. It is one of the most destructive quadrupeds found in the northern part of America, where it is much more numerous than in Northern Europe or Asia. Trappers hate it for destroying traps, bait, and fur animals; it is a great enemy to the beaver. Among other fabulous accounts of this animal is that given by Olaus Magnus, that it eats so voraciously that it is forced to go between two trees growing close together in order to squeeze out part of the food. The molar teeth are—pre-molars four above and below; molars, one above and two below on each side. See plate at CARNIVORA.

GLUTTONY. One of the most disgusting of vices, and, according to the Catholic Church, placed amongst the seven deadly sins, consists in an extraordinary and depraved indulgence of appetite, whether in solid or fluid food. When it exists as a disease it is called bulimia, *fames canina*, or dog-like hunger, and the person must either be indulged with food or falls into fainting fits. The unfortunate sufferer is then rather an object of pity than of disgust or contempt. Fuller, in his Worthies, mentions a man named Nicholas Wood, of Harrison, in Kent, who had once eaten a whole sheep, raw, at a single meal; and at another time thirty dozen of pigeons; who once, at Lord Wotton's, devoured eighty-four rabbits, and ate 18 yards of black-pudding for a breakfast. There was also a counsellor at law, named Mallet, who lived in the reign of Charles I., who, at one meal, ate up a whole ordinary provided in Westminster for thirty men; and his income not being adequate to procure him a sufficiency of good food, he generally fed upon offals, ox livers, hearts, and other entrails. But this man having lived to be sixty years old, during the last seven years of his life a change took place in his constitution, and he ate as moderately as other men. In the Roman history many instances are related of the most disgusting gluttony, both amongst the Roman emperors themselves and their subjects. Hardiknute, too, who was the last of the Danish race of kings in England, was addicted to this horrible propensity, to which he fell a victim, having dropped down dead during a wedding banquet in his palace at Lambeth.

GLYCERIN ($C_3H_8O_3$). In 1783 Scheele observed that by acting on olive-oil with oxide of lead he obtained a sweet substance, and in the following year he showed that the same body could be got from other oils and fats, such as butter. He also observed that it formed a syrupy fluid, but was not crystallizable; that though it had a sweet taste like sugar it could not be fermented; and though it gave oxalic acid by oxidation, it differed from sugar in many respects. He failed, however, to ascertain its true relation to the oils which furnished it, and to the lead plaster which accompanied its formation. The true explanation of the reactions was given some thirty years later by Chevreul, in his famous researches upon the animal fats, which were begun about 1811, and were concluded in 1823. In the course of these he showed that an animal fat consists of one or a mixture of several fats, and that each individual fat is a compound, which, when saponified by an alkali, or by lime, or by oxide of lead, is decomposed into *glycerin*, and a compound of the metallic oxide employed with a fatty acid. Since that time glycerin and its relations to other bodies have been carefully studied, and it is now universally agreed to regard it as a body analogous to alcohol, which undergoes analogous reactions, forming an acid, an oxide, substitution compounds, and ethers, of which the fats form the most important members, and are distinguished by the name of *glycerides*.

Glycerin sometimes occurs naturally uncombined in palm-oil, it is also a product of the fermentation of malt, but it is obtained on the large scale only by the decomposition of the fats. In soap-making the fat is decomposed by an alkali, and the soap dissolved in the water is precipitated by addition of common salt. The water after the soap is removed contains the glycerin, which can be separated by distilling in a partially exhausted boiler; the glycerin passes over with the vapour of water, and the excess of water can be afterwards got rid of by evaporation.

Large quantities of glycerin are obtained in the preparation of so-called stearin candles. In this case the fat is not saponified by an alkali, but simply by superheated steam, which decomposes it with the formation of stearic acid and glycerin. A similar decomposition is wrought on fat by a mineral acid, but the disadvantage in this case is that the mineral acid may enter into combination with the fatty acid, or the glycerin, or both, involving a subsequent treatment to effect its removal. The preceding are the more important manufacturing methods; besides these there are other methods of interest from a chemical point of view.

Pure glycerin is a thick, colourless, odourless, sweet liquid of sp. gr. 1·27, which sometimes solidifies at a low temperature to a crystalline mass. It absorbs moisture from the air, and dissolves in or mixes with water and alcohol in all proportions, but is insoluble in ether. It acts as a solvent both on inorganic and organic bodies. Thus it dissolves metallic oxides, such as lime and baryta, arsenious acid and oxide of copper; borax, chloride of iron, sulphate of copper, common salt, potash and soda, iodine and bromine. It also dissolves many of the vegetable alkaloids and the acids. It distils when heated with water, but when heated by itself it undergoes decomposition to some extent, this being accompanied by the evolution of an excessively acrid substance called acrolein, of acetic acid, of acrylic acid, and other bodies. When glycerin is kept in contact with yeast it is slowly converted into formic, acetic, and propionic acids, the three lowest members of the series of fatty acids (which see); a similar decomposition occurs on heating with an alkali. By oxidation it is converted into *glyceric* and *oxalic* acids.

With regard to its chemical constitution glycerin is usually described as a triatomic or trihydric alcohol, which is therefore capable of forming three distinct classes of compound ethers. These compounds are called mono-, di-, or tri-glycerides, according as the glycerin has reacted with one, two, or three proportions of acid; sometimes the compound receives its name from the acid which is present. Several of these glycerides occur naturally in the fats, as has been already mentioned, while others have been formed artificially by bringing glycerin and the acid together, or indirectly by a double decomposition.

Thus of the natural glycerides may be mentioned: butyric glyceride, or tributyrin, which is a constituent of butter; palmitic glyceride, or tripalmitin; stearic glyceride, or tristearin; oleic glyceride, or triolein, which are the chief constituents of oils and fats. Of the artificial glycerides may be enumerated mono-, di-, and tri-acetin, mono- and di-butyrin, and corresponding compounds, with palmitic, stearic, and oleic acids. To the artificial glycerides belongs also trinitro-glycerin, or as it is commonly called nitroglycerin (which see); while phospho-glyceric acid is a compound which occurs naturally in egg-yolk, in the bile, and in the brain.

Glycerin is largely used for making nitro-glycerin, as a solvent in pharmacy, for surgical dressing, for making various toilet requisites, such as soaps, creams, and washes, and in the arts for a great variety of purposes. The consumption of these is so great that glycerin is now manufactured on a considerable scale.

GLYCOCHOLIC ACID ($C_{26}H_{43}NO_6$). The sodium salt of this acid is one of the main constituents of the bile of some of the Vertebrata, while in others it is present in only small amount. It is best obtained from ox-bile by evaporating to dryness; powdering the residue, extracting with cold alcohol, and adding a small quantity of ether. A tough mass deposits, which is repeatedly treated with ether, and then dissolved in water in presence of ether, and sulphuric acid added. Glycocholic acid gradually deposits, and it can be purified by recrystallization from water. It forms fine needles, which are very sparingly soluble in water, but dissolve in alcohol, and readily also in ether. The solution in water has an acid reaction and a faintly sweet taste. It combines with bases to form *glycocholates*, which are more soluble in alcohol than in water; some of them indeed are insoluble in that menstruum. When heated with potash glycocholic acid is resolved into cholic acid and glycocol (which see).

GLYCOCOL, GLYCOCINE or AMIDO-ACETIC ACID ($C_2H_5NO_2$). This is one of the substances yielded by glycocholic acid on treatment with an alkali, and by gelatin or glue and gelatinous tissues on continued boiling with sulphuric acid or with potash. It forms hard, granular, monoclinic crystals, is sparingly soluble in water, but dissolves in dilute alcohol. The solution has a sweet taste. When heated it becomes brown, and if the action be long-continued it is ultimately decomposed. When treated with alkalies and strong acids ammonia and other nitrogenous compounds are liberated. Glycocol is a somewhat singular body when its properties are compared with its composition. According to its mode of formation from glue it is a sugar, the glue acting the part of a glucoside (which see); in solution it has an acid reaction, and combines with metallic oxides to form salts called *glycollamates*, the substance itself being an acid; on the other hand, it is capable of combining with acids to form salts, such as the acetate, oxalate, sulphate, nitrate, and hydrochloride, so that it is possessed of distinct basic properties, and is indeed usually described as a base. These somewhat irreconcilable properties are supposed to be explained by the theory that it is so constituted as to occupy an intermediate position between glycollic acid and glycollamide.

GLYCOGEN ($C_6H_{10}O_5$), *animal starch*, a substance found in the liver of most animals, and to a very large extent in the muscles and other parts of fœtal animals. It is extracted from the liver of a newly-killed animal by cutting the liver in pieces, plunging it into boiling water, triturating it to a fine paste, and extracting with water. The filtered fluid is mixed with not too strong spirit, which throws down a flocky precipitate. This is purified from colouring and nitrogenous matter, and at last the glycogen is obtained as an amorphous white powder—without taste or smell. It dissolves in water, but the solution is not absolutely clear; it is insoluble in alcohol. By boiling with acids, by the action of ferments, &c., glycogen is readily converted into sugar. By nitric acid it yields oxalic acid. The chief interest attaches to the physiological importance of this substance, and the very discordant views taken by different writers. Thus it is said to be the substance in the liver mainly concerned in the conversion of starch into sugar. Other physiologists affirm that no such transformation takes place, there being no proof of the increase of sugar after the action of the liver; so that at the present time its exact functions are unknown.

GLYCOL, or ETHYLENIC ALCOHOL, the type of a series of substances called diatomic or dihydric alcohols. Analogous compounds, the propylenic, butylenic, amylenic, hexylenic, octylenic, and aromatic glycols are known, but they have not been much examined. The glycols as dihydric stand between the common alcohols, which are monohydric, and glycerin, which is trihydric. Accordingly glycol can yield two different series of ethers, and by oxidation it furnishes in the first instance glycollic acid, and by further oxidation oxalic acid. Glycol itself has the composition $C_2H_6O_2$ or $C_2H_4(OH)_2$; it is a colourless, odourless, viscid liquid, which boils at 387·5° F., and has a specific gravity 1·125. It mixes with water and with alcohol, and dissolves some substances, but not so well as glycerin. A great number of ethers and substitution compounds have been made, but they are not of general interest.

GLYCOLLIC ACID ($CH_2OH\ COOH$) appears to be capable of existing in several forms, for sometimes it is got as a syrup by one process, sometimes crystallized by another. This acid is produced when glycocol is decomposed by nitrous acid, when alcohol or glycol is oxidized by nitric acid, and when oxalic acid is treated with zinc dust and dilute sulphuric acid. Glycollic acid is very soluble in water and in alcohol; when heated the solid acid fuses, and at last distils over. It combines with the bases, and forms a large series of salts called glycollates, and it yields besides ethers and other organic derivatives. Glycollic acid is (excluding carbonic acid) the lowest member of the homologous series to which lactic acid belongs.

GLYCYRRHIZIN ($C_{24}H_{36}O_9$) is a glucoside, which on boiling with dilute acids is resolved into glucose and glycyrretin, a brownish resin, apparently unaffected by water, but soluble in oil of vitriol. Glycyrrhizin is obtained from liquorice root by infusing in water, adding sulphuric acid, washing the precipitate, and purifying with alcohol or with alcohol and ether. It is a yellow powder, soluble in alcohol and in hot water, but sparingly in cold. Glycyrrhizin does not ferment. Its taste is both sweet and bitter.

GLYPHOGRAPHY, an electrotype process, wherein, by depositing a coating of copper upon an engraved plate previously prepared in a peculiar

manner, a copy in metal is obtained with a raised surface, suitable for being printed after the manner of ordinary letterpress. See ELECTRO-METALLURGY.

GMELIN, JOHANN GEORG, a German naturalist, professor of botany and chemistry in Tübingen, where he was born in 1709, and where he studied until 1727. He then went to St. Petersburg, with his teachers, Bilfinger and Duvernoi, and in 1731 became professor of chemistry and natural history. In 1733, at the command and at the expense of the Empress of Russia, he travelled to Siberia, in order to examine the country. From this laborious but highly instructive expedition he did not return until 1743. He died in 1755, at Tubingen. He early became acquainted with natural history and chemistry, for the study of which latter science he had a good opportunity in the house of his father, who was a respectable apothecary. His persevering efforts obtained him the reputation of being one of the greatest botanists of his time. His principal works are his Flora Sibirica and his Travels.

GMELIN, LEOPOLD, a distinguished German chemist, was born on 2d August, 1788, at Göttingen, where his father, Johann Friedrich Gmelin, was professor of chemistry. He was descended from the celebrated chemist and botanist Johann Georg Gmelin, the subject of the preceding article. At Göttingen young Gmelin received his first education, and subsequently studied at the University of Tübingen. After various tours to different parts of Europe, including Vienna, Rome, and Naples, where he assiduously devoted himself to the acquisition of scientific information, he at last settled down in Heidelberg as a lecturer on chemistry, of which, in 1814, he was nominated extraordinary professor. In 1817 he was appointed ordinary professor of chemistry in the Heidelberg University. In this situation he continued till an attack of apoplexy, following one which had occurred two years previously, compelled him in 1850 to retire from his professional duties. He still, however, continued his scientific labours till 1852, when an affection of the brain, which for some time had been making insidious progress, acquired such a development as completely prostrated him, and after considerable suffering he expired on 13th April, 1853. Gmelin's great work is his Handbuch der theoretischen Chemie (Manual of Theoretical Chemistry), five vols. Heidelberg, 1841–52. This book is about the first of its class for universality and completeness, and possesses the especial characteristic of presenting all that is known and has been ascertained in chemical science by actual observation, without obtruding on the reader the individual views and speculations of the author. The work was carried on after his death, the latest part appearing so recently as 1870. It has been translated into English by Mr. Watts, and published by the Cavendish Society in eighteen 8vo volumes. Besides this, Gmelin is the author of a great number of papers published in different periodicals, and of some other distinct works.

GMELIN, SAMUEL GOTTLIEB, a nephew of Johann Georg Gmelin, was born in 1743, at Tübingen, where he studied physic, and, in 1763, took the degree of doctor of medicine. He afterwards visited Holland and France, and, in 1767, received an invitation to a professorship in the academy at St. Petersburg. The year following, by the command of the empress, he commenced, together with Pallas, Guldenstadt, and Lapuchin, a scientific tour through Russia. In 1769, he travelled along the western side of the Don, and passed the winter in Astrakhan; in 1770 and 1771 examined the Persian provinces on the south and south-west side of the Caspian Sea; in 1772 returned again to Astrakhan, and there surveyed the regions on the Volga, and in 1773 the dangerous countries east of the Caspian Sea. On his return, however, in 1774, he was imprisoned by the Khan of the Chaitaks, and died in confinement, July 27, of dysentery. His widow received from the Russian empress 2000 rubles. His most important works are his Historia Fucorum, and his Travels in Russia (Reisen durch Russland zur Untersuchung der drei Naturreiche).

GMELINITE, a hydrated silicate of aluminium and calcium, which generally contains small quantities of alkalies. It crystallizes in rhombohedra, is moderately hard, has a pink or yellow colour, with a vitreous lustre. When heated it loses water; at a high temperature it fuses to a white enamel; by acids it is decomposed, the silica separating in the gelatinous form. The localities where this mineral has been found are Skye, the north-east of Ireland, and Italy.

GMÜND, a town, Würtemberg, on the left bank of the Rems, here crossed by a handsome bridge, 23 miles east of Stuttgart. It is a cheerful-looking and well-built place, surrounded by walls flanked with towers, and has several churches, one of them a handsome Gothic structure, a town-house, and a considerable trade in gold and silver ornaments, copper, bronze, and brass wares, &c. Pop. (1900), 18,699.

GMUNDEN, a town, Upper Austria, beautifully situated among magnificent scenery, on the Traun, where it issues from the northern extremity of the lake of that name, 35 miles south-west of Linz. It is well built, and has a parish church with a finely carved altar, and an antique town-house. It is a favourite bathing-place and summer resort, with numerous hotels and villas. Most of the inhabitants of the town are employed in the salt-mines, and in the lake fisheries. Pop. (1890), 6477; (1900), 7126.

GNAT (*Culex*). These well known and troublesome insects are distinguished by having the body and feet very long and downy; antennæ garnished with hairs, which are long in the male, short in the female; large eyes; a proboscis composed of a membranous cylindrical tube, terminated by two lips, inclosing the mandibles and maxillæ, which are free, and have the form of fine serrated stilets. The wings are placed horizontally over each other. The gnat of this country is comparatively harmless; but those of warmer climates are peculiarly annoying, especially in marshy situations. They pursue the inhabitants, enter the houses, especially in the evening, announcing their arrival by a sharp buzzing noise. When they bite the stilets are plunged through the skin, the sheath or proboscis drawn up towards the breast. It is uncertain whether the pain of the wound is due to the injection of an irritating fluid, or to the irritation of the terminal nerve filaments, but ammonia gives speedy relief. It is a curious fact that it is only the females which are thus tormenting. One species of these insects is known under the name of *mosquitoes*, against whose attacks various means have been resorted to in different countries, as curtains of gauze, and various essential oils, the latter of which appear to be only partially successful. The Laplanders drive them off by means of smoke, and anointing their bodies with grease. These insects also feed on the juice of plants. The female deposits her eggs on the surface of the water in a long mass. In their larva state these animals are aquatic during the greater part of the summer. All stagnant waters are full of these small worms, hanging with their heads downwards, whilst their hinder parts reach the surface of the water. At this stage the stigma or respiratory orifice is placed on the last segment of the body; they are also, in this condition of existence, provided with small caudal lamellæ or fins. After having remained

in the larva state for about twenty days, they are transformed into chrysalids, in which all the limbs of the perfect insect are distinguishable, through the diaphanous robe with which they are then shrouded. After remaining three or four days wrapped up in this manner, during which, however, they continue active, though incapable of taking food, they become gnats, and ascend into a new element. No sooner does the chrysalis reach the surface of the water than the insect with its head bursts the shell, which then serves it for a boat, of which its wings are the sails. If in this critical moment a breeze arises, it proves a dreadful hurricane to these pigmy sailors; for it oversets the little bark, and the insect, not being yet disengaged from it, suffers a fatal shipwreck. If, however, the weather prove calm, the gnat makes a more prosperous voyage. Having time to dry his wings before leaving the boat, he is enabled to mount into the air, where, contemptible as he may seem, he soon becomes the inveterate tormentor of the lords of the creation. See MOSQUITO.

GNEISS, one of the three most abundant rocks of our globe, of which granite and mica-schist are the other two. They are composed of quartz, felspar, and mica, and possess a distinctly crystalline structure. They appear to pass by gradation into each other, and might, perhaps, with more propriety, be regarded as varieties of the same rock, than as different species. Gneiss received its name from the German miners, who applied it to a decomposed stone forming the sides of certain metallic veins; but Werner fixed the acceptation at present attached to the word, which is that of a schistose or slaty granite, abounding in mica. Granite frequently passes into gneiss by an almost imperceptible gradation: when the quantity of felspar decreases, and the crystalline grains become smaller, if the mica increases in quantity, and is arranged in layers, the rock loses the massive structure, and becomes schistose;—this then is a true gneiss. When the mica becomes very abundant, and the other constituent parts are small in size and quantity, gneiss passes into mica-schist. Hornblende sometimes takes the place of mica in the composition of gneiss. When this is the case, the rock is called *hornblende gneiss*, or *gneissoid hornblende*. Gneiss is a rock much less prolific in disseminated minerals than either of the other primary rocks above mentioned. It occasionally, however, contains garnets interspersed through its strata. But the metallic veins and beds of other minerals which it presents are very remarkable. Thus gold is found in it in Dauphiny, at the foot of Monte Rosa; silver, cobalt, and antimony near Allemont; and lead and silver in Auvergne, at Freiberg, and in Bohemia. The famous copper mines at Fahlun, in Sweden, occur in this rock. It contains iron ore in profusion also, as in the mines of Scandinavia, at Dannemora, Utoe, and Arendal; and in the United States, upon the borders of Lake Champlain; at Franconia, in North Hampshire, and in the northern parts of North Jersey. Gneiss embraces also extensive deposits of white crystalline limestone and of serpentine, the beds of which are frequently so thick as to compose mountain masses. Rocks of this description in the Laurentian gneiss of Canada have yielded a supposed foraminiferous fossil named *Eozoon Canadense*, this being, if really a fossil, the oldest organism ever yet detected. With regard to the distribution of gneiss, it may be remarked that it is the principal rock of very extensive districts. It forms the declivities of immense mountain chains of granite, and even constitutes entire mountains of itself. It is the predominating rock of Norway and of all the north of Europe. It abounds in the southern Alps and the Pyrenees, and forms the loftiest chains of the Andes of Quito. In the United States, also, gneiss is a predominating rock, especially in New England and the eastern and southern parts of New York. The direction of its strata in these states is from the north-east to the south-west, with a dip to the north-west of from 50° to 80°. Gneiss is a rock much used in the United States for the purposes of architecture, and is particularly esteemed in all its larger cities, as furnishing the best flag-stones.

GNESEN, or GNIEZNO, a town, Prussia, province of Posen, in a fertile district, between hills and lakes, 45 miles south-west of Bromberg. It is an ancient place, surrounded by walls; is the see of an archbishop, who in early times was primate of all Poland; and has a handsome cathedral, in which the kings of Poland used to be crowned. Its chief industrial establishments are distilleries, breweries, tanneries, and cloth and linen manufactories, and the trade is in horses and cattle. Pop. (1900), 21,693.

GNOME (Greek, *gnōmē*), a short, pithy saying, often expressed in figurative language, containing a reflection, a practical observation, or a maxim, common among the oldest eastern nations. The Proverbs of Solomon, those of Jesus, son of Sirach, and the sermon on the mount, are examples. Every nation preserves its first observations and discoveries in the moral world in short, pithy, striking sentences. The Saemundian Edda has preserved excellent proverbs under the name of Odin. Among the Greeks Theognis, Phocylides, and others, are called the *Gnomic poets*, from their sententious manner of writing.

GNOME. Modern mythology has given this name to the spirits which dwell in the interior of the earth, where they watch over hidden treasures. They assume a variety of forms, and are sometimes beautiful and sometimes hateful. Ugliness, however, is their appropriate quality, though the females, *gnomides*, are originally beautiful. Among them all Rübezahl (Number-nip), by means of Musäus' popular tales, has obtained the greatest celebrity in Germany. The native country of these poetical beings is the East, and they belong to the cabalistic phantasms. The Talmud informs us that a gnome, in the form of a worm of the size of a barleycorn, was very useful to Solomon in the building of his temple by splitting large masses of rock for him and transforming them into smooth slabs without any assistance. Solomon, it seems, employed many arts and much labour to obtain possession of this gnome. These elves were introduced into Europe by the cultivation of the cabalistic philosophy, since the time of Raymund Lully, from the middle of the fifteenth to the beginning of the sixteenth century, by Pico of Mirandola, Marsilius Ficinus, Paracelsus, Cardanus, and Reuchlin. The gnomes make a part of Pope's machinery in the Rape of the Lock.

GNOMON, in astronomy, is an instrument or apparatus for measuring the altitudes, declinations, &c., of the sun and stars. The gnomon is usually a pillar or column, or pyramid, erected upon level ground or a pavement. For making the more considerable observations, both the ancients and moderns have made great use of it, especially the former; and many have preferred it to the smaller quadrants, both as more accurate and more easily made and applied. The most ancient observation of this kind extant is that made by Pytheas, in the time of Alexander the Great, at Marseilles, where he found the height of the gnomon was in proportion to the meridian shadow at the summer solstice as 213½ to 600; just the same as Gassendi found it to be, by an observation made at the same place almost 2000 years after, viz. in the year 1636. This method of obser-

vation, however, is by no means accurate, as is proved by the following deficiencies in the ancient observations made in this manner:—1. The astronomers did not take into account the sun's parallax, which makes his apparent altitude less than it would be if the gnomon were placed at the centre of the earth. 2. They neglected refraction, by which the apparent height of the sun is somewhat increased. 3. They made their calculations as if the shadows were terminated by a ray coming from the sun's centre; whereas it is bounded by one coming from the upper edge of his limb. These errors, however, may be easily allowed for; and, when this has been done, the ancient observations are generally found to coincide nearly with those of the moderns.

Gnomon, in geometry, is the space included between the lines forming two similar parallelograms, of which the smaller is inscribed within the larger, so as to have one angle in each common to both. For the gnomon of a dial see DIAL.

GNOMONICS, the art of dialling, or of drawing sun and moon dials, &c., on any given plane, so called, as it shows how to find the hour of the day, &c., by the shadow of the gnomon or style.

GNOSTICS (Greek, *gnosis*, knowledge). This name was assumed by a religious philosophical sect, which combined the fantastic notions of the oriental systems of religion with the ideas of the Greek philosophers and the doctrines of Christianity. There were sages as early as the times of the apostles who boasted of a deeper insight into the origin of the world, and of the evil in the world, than the human understanding, so long as it remains in equilibrium, can deem admissible, or even possible. Simon the magician, of whom Luke speaks in the Acts of the Apostles, was the first among them. Even in *his* dogmas we discover the traces of ideas which were common to all the Gnostics; and they bear the unquestionable impression of an oriental, particularly of a Persian and Chaldaic origin. They may be reduced to the following heads:—God, the highest intelligence, dwells at an infinite distance from this world, in the Abyss, removed from all connection with every work of temporal creation. He is the sum of being, yet the extreme of abstraction, and is even called the Not Being. He is the source of all good; matter, the crude, chaotic mass of which all things were made, is, like God, eternal, and is the source of all evil. From these two principles, before time commenced, emanated beings called *æons*, which are described as divine spirits, inhabiting the Pleroma, the plenitude of light, which surrounds the Abyss. The world and the human race were created out of matter by one æon, called the *demiurge*, or, according to the later systems of the Gnostics, by several æons and angels. The æons made the bodies and the sensual soul of man (*sensorium, psychē*) of this matter; hence the origin of evil in man. God gave man the rational soul; hence the constant struggle of reason with sense. What are called gods by men (for instance, Jehovah, the God of the Jews), they say, are merely such æons or creators, under whose dominion man became more and more wicked and miserable. To destroy the power of these creators, and to free man from the power of matter, God sent the most exalted of all æons, to which character Simon first made pretensions; he was followed in these pretensions by Menander, a Samaritan, the most celebrated of his scholars, who, towards the end of the first century, founded a sect at Antioch in Syria. Simon and Menander were enemies to Christianity. Cerinthus, a Jew, of whom John the evangelist seems to have had some knowledge, combined these reveries with the doctrines of Christianity, and maintained that the most elevated æon, sent by God for the salvation of man, was Christ, who had descended upon Jesus, a Jew, in the form of a dove, and through him revealed the doctrines of Christianity, but before the crucifixion of Jesus separated from him, and at the resurrection of the dead will again be united with him, and lay the foundation of a kingdom of the most perfect earthly felicity, to continue 1000 years. In the second century, during the reign of Hadrian and both the Antonines, these principles were adopted by the Christian philosophers, who are more particularly known under the name of Gnostics, and still further refined, extended, and systematized. Saturninus, a Syrian, speaks of an unknown supreme God, who had generated many angels and powers; seven of these æons were, according to him, creators of the world, and soon fell from God; one of them, the God of the Jews, had seduced man to him, whence originated the difference between good and bad men. Saturninus also calls Christ the Saviour sent by God, and the Son of God; but the opinion that Christ was not actually born, and had not a real human body, but only an incorporeal image, is peculiar to him, on which account his followers and other later Gnostics who agreed with him in this respect were called *Docetæ* (from Greek *dokein*, to seem) and *Phantasiasts*. Saturninus very consistently denied a resurrection of the body, and admitted only a return of the souls of good men into the being of the Godhead. His sect was distinguished by austerity of manners, by their abstinence from flesh, and by their rejection of matrimony. Basilides, his contemporary, an Alexandrian, was distinguished from him by the use of a language imitated from the Egyptian priests, though yet more mystic than theirs. According to him the generations of several (celestial) degrees, each containing seven æons, and of which his kingdom of light consists, are emanations, and every inferior family or order of this kingdom is a copy of the higher. The internal harmony of the lowest order of this kingdom of light was disturbed by the kingdom of darkness, which, perceiving its rays, endeavoured to form a union with it. Pure natures were therefore drawn downwards into the dead mass, out of the former kingdom, and became engaged singly in purifying combats with matter. Hence arose the visible world, the object of which is the final separation of the good, and of those allied to the kingdom of light, from the material dross. The souls or natures fallen from light pass for their purification in this world through different bodies and conditions, which Basilides proves from the different degrees of fortune and the different education of men. The highest point of this purification, however, was unknown to the most exalted æon of the lowest order, whom Basilides considers the creator of the world. Therefore, the first-born of the supreme original being united itself with the man Jesus on his baptism in Jordan in order to redeem souls, that is, to elevate them above the worldly course to the highest order of the kingdom of light. His sufferings were but those of an innocent child, which shares the lot of human nature, and had no relation to his work. This is accomplished by the faith of the souls in Christianity, which Basilides calls an elevation of the soul, arrived to a consciousness of its destination, into the kingdom of light. Although this poetical view differed widely from the simplicity of the Christian religion, and betrayed the indulgence of a philosophizing fancy, still Basilides concurred in the Christian system of morals, and disapproved only of seeking a martyr's death. The mysterious colouring and the glitter of Basilides's theories procured him many followers. They often misunderstood him, however, and gave themselves up to many superstitious notions about abraxas stones and amulets

Isidore, his son, extended his sect, which in the fourth century entirely disappeared. The system of Carpocrates, an Alexandrian, who also flourished during the reign of Hadrian, was distinguished from the one which we have just described in this respect only, that he considered Christ as a mere man, whose purer and more powerful soul had more accurately remembered what it had seen with God before its union with the body. The fathers of the church, Clement of Alexandria, Irenæus, Eusebius and Epiphanius, from whom, in general, we derive all our information concerning the Gnostics, accuse the moral system of Carpocrates of destroying all distinctions between good and evil, and inculcating an unlimited indulgence of the sensual appetites. Certain it is that his followers practised the most detestable vices, and were the cause of many of the calumnies of the heathen writers concerning the Christians of this century. The most conspicuous of Carpocrates' scholars was Prodicus, who has, however, been erroneously called the founder of the sect of Adamites (which see). The sect of Carpocratians, however, which, in Egypt and Italy, but especially in the islands, met with much success, became extinct as early as the beginning of the third century. The most complete and ingenious of all the Gnostic systems was founded in the second century by Valentinus, a learned and eloquent Alexandrian. In that light or plenitude, which all the Gnostics speak of as surrounding the residence of the Supreme God, he has placed fifteen male and as many female æons, produced by successive intermarriages. The Supreme God, the Unbegotten, the Original Father, whom he also calls the *Deep* (Bathos), confounding the Being with his dwelling-place, is the first of these æons; Thinking Silence was his wife, and Intelligence, a male, and Truth, a female, were their children. These produced The Word and Life, the latter a female, who gave birth to mankind and society. These eight constituted the first class of the thirty æons. The second class, of five couples, at the end of which stood the Only Begotten, and the third, of six couples, at the head of which stood the Comforter, were, in a similar manner, descended from Mankind and Society, and consisted, like the first, of personified ideas. The officers of this heavenly state are four male æons—Horus, who guards the boundaries of the region of light; Christ and the Holy Ghost, which instruct the other æons in their duties; and Jesus, whom all the æons of the kingdom of light begat in common, and endowed with their gifts, as all the inhabitants of Olympus did Pandora. Wisdom, the last female æon of the third class, envied Intelligence on account of his knowledge, and, in the heat of her unrestrained passion, produced an unformed female æon, Achamoth or Enthymesis (Reflection, Consideration), which fell into the darkness of matter, and was endowed with a form by Christ out of compassion. Achamoth longed for the lost heavenly light. Fear, anguish, melancholy, and laughter alternately took possession of her. Her ungratified desire at length produced the soul of the world and other souls. From her tears originated the water; from her laughter, transparent matter; and from her sorrow, opaque matter. Christ was moved with compassion for this fallen creature, and sent her Jesus, who communicated to her knowledge, and delivered her from her pain. After this fortunate change she bore three substances—a material, a spiritual, and a soul-like substance. Out of the last the demiurgus, or the creator of the world, was formed, who, according to Basilides, made the heavens with their angels out of this soul-like substance, and selected the highest of these heavens for his own mansion. Of the material substance, under the influence of Achamoth's fear, beasts were made; under the influence of her melancholy, wicked spirits, whose prince is the lord of the world; and under the influence of her anguish, the elements of the world which contain fire. Man is formed out of all three substances. Christ, the Saviour of men, when he appeared on earth had a visible body made of finer material, and was composed of the spiritual and the soul-like substance only. At his baptism the æon Jesus united itself with him, and instructed mankind. Valentinus describes the occurrences of his life and his good deeds, like Saturninus, with the exception of one peculiarity. He says that when all the spiritual parts shall have been delivered from matter, Achamoth will unite herself with Jesus in the divine region of light; that she will draw the good souls to herself; that the heaven of the demiurgus will receive the most virtuous, and that the world will be consumed with fire. The Valentinian party, which rose towards the middle of the second century in Rome, and especially in Cyprus, and which was distinguished by its austere manners, was the most numerous of all the Gnostic sects, and continued until after the commencement of the fourth century. Marcion of Sinope, and Cerdo, a Syrian, renounced many of the absurdities of the earlier Gnostics, and formed a regular system, the characteristic of which was the rejection of the Old Testament. Marcion distinguished two supreme principles, God and the devil. The true God begat many spirits, among which were the creator of the world, the righteous God, and the lawgiver of the Jews. The last, through the prophets, promised Christ; but Jesus, who actually appeared, and is the true Redeemer, was the Son of the truly good God, and not the Jewish Messiah. This peculiar dogma of Marcion caused his separation from the Catholic Church, in which Tertullian in particular successfully defended the honour of the Old Testament against him. The Marcionites were very numerous, and had, even to the beginning of the fifth century, many societies, and their own bishops in Italy, Syria, Arabia, and Egypt; and they maintained the reputation of blameless lives, while, according to the precept of their founder, in order to have as little as possible to do with matter, they avoided eating flesh, drinking wine, and matrimony. It is doubtful whether Marcion and Cerdo were also the founders of the sect which, towards the end of the second century, arose under the name of the *Ophites*, and which, on account of the resemblance of their theogony to that of the Valentinians, were reckoned among the Gnostics. In the same period Tatian, a Syrian, who had distinguished himself by his Harmony of the Four Gospels and his discourses against the Greeks or heathens, adopted Gnostic doctrines, and founded a sect the followers of which, after one of his pupils, were called *Severians;* on account of their austerity, *Encratitæ* (self-denying) or *Hydroparastatæ* (water-drinkers); and because they renounced all property, *Apotactitæ*. Bardesanes, a Syrian, and Hermogenes, an African, who, in the reign of the Emperor Commodus, apostatized from Christianity, and established sects, bordered, in their hypotheses concerning the origin of good and evil, upon Gnosticism. On the whole, when we take into consideration the philosophical tendency of that age, the passion for the marvellous that had taken possession of the effeminate nations of the Roman Empire, and the custom of pretending to a deeper insight into the secrets of nature and the divinity, it is not to be wondered at that a religious philosophy which adopted the most brilliant parts of Platonism, and which afforded nourishment alike to the imagination and to the vanity of secret wisdom, should have met with such universal success. By the austerity of its precepts, and its care for the well-being of the soul,

it even prepossessed good men in its favour. The Gnostics were the Pietists of the third and fourth centuries. The Catholic Church took occasion from their heresy to give greater precision to the articles of the orthodox faith. There have been no Gnostic sects since the fifth century; but many of the principles of their system of emanations reappear in later philosophical systems, drawn from the same sources as theirs. Plato's lively representation had given to the idea of the Godhead something substantial, which the Gnostics transferred to their æons; and Leibnitz's Effulgurations of God, Ploucquet's Real Presentations of God, St. Martin's Pictures and Mirrors, and the like, as well as the Gnostic Æons, are a proof that the essays of the human understanding to explain the creation and the origin of imperfect beings from the perfect always end in similar results. See Neander, Genetische Entwickelung der vornehmsten Gnostischen Systeme (Berlin, 1818); Matter, Histoire Critique du Gnosticisme (second edition, Strassburg, 1843); Baur, Die Christliche Gnosis (Tübingen, 1835); King, The Gnostics and their Remains (2nd ed., 1887); and Anz, Zur Frage nach dem Ursprung des Gnosticismus (1897).

GNU, a Hottentot name of one of the two species of wildebeest. The wildebeests are African antelopes, forming the genus *Catoblepas*. The common gnu or horned horse (*C. gnu*) resembles, in form, partly the horse, partly the buffalo, and partly the stag. It is as large as a middle-sized horse. Its neck, though neither so long or slender as that of the horse, is more so than that of the buffalo, and is adorned with a stiff erect mane. On the forehead, between the nose and flexures of the horns, the face is covered with an oblong tuft of stiff black hairs, turned upwards. Beneath the lower jaw is also a thick, shaggy beard. Its legs are long, and elegantly formed, like those of the stag; the space between the fore-legs is covered with long bushy hair. The tail is long and white. Its horns are rough, and are enlarged at their base like those of the buffalo; they spring from the hinder part of the head, and, after bending forward beyond the eye, turn suddenly upwards. Both sexes are furnished with these appendages. In the young animal they are perfectly straight, acquiring their flexure as the animal grows older. These animals are provided with lachrymal openings under the eyes. The gnu is affected by the sight of scarlet, like the buffalo or bull. When irritated, it expresses its resentment by plunging, curveting, tearing the ground with its hoofs, and butting with its head. The flesh is juicy, agreeable, and nourishing. When taken young they are readily tamed; but the inhabitants of South Africa seldom attempt to domesticate them, as they are said to have a tendency to catch and communicate to the other cattle a dangerous infection. This animal is not uncommon in our zoological collections. The other species (*C. taurina*) is found from Uganda southwards to the Orange River. It has no long hair in front between the fore-legs, there are dark stripes on the sides, and the tail is shorter and black. See illustration at UNGULATA.

GOA, a Portuguese territory and seaport in Hindustan, on the Malabar coast, the town being near the mouth of the river Mandávi, 260 miles S.S.E. of Bombay. The town, distinctively known as New Goa or Panjim, is capital of the Portuguese possessions in India, which include Damán and Diu besides Goa. Old Goa, now almost entirely deserted, is situated 5 miles farther inland than New Goa. Old Goa, deserted on account of its unhealthiness, was at one time a populous and magnificent city, as the elegant specimens of ancient architecture exhibited in its cathedral and numerous other religious edifices sufficiently prove. There are here several convents, the edifice formerly occupied by the Inquisition, and the viceroy's palace. The whole buildings are going fast to ruins, and were used as a quarry whence to obtain building materials for the new town, to which everything worthy of preservation and easily removed has been transported, including the tomb of Francis Xavier, the Jesuit missionary. A few monks, however, still reside in this deserted place, and make fruitless attempts to keep certain edifices in repair. New Goa or Panjim, founded in the beginning of the eighteenth century, is walled and fortified. It is situated about 3 miles from the river's mouth, and is a handsome, well-built town, with streets wide and straight. It is now the seat of business, the see of an archbishop, who is styled Primate of the East, the residence of the viceroy and of the principal Portuguese inhabitants. The houses are of stone, with thick walls pierced with small grated windows, and roofed with tiles; and altogether it presents much the appearance of a European town. The harbour is a noble and capacious basin, formed by the mouth of the river, landlocked and well protected from the monsoon, and overlooked by a fortress, at the foot of which stands the large and commodious custom-house. The salt manufacture is the chief industry. The trade of Goa, at one time the most extensive of any place in India, is now inconsiderable. It is largely transit, and is mostly in grain, pulse, and salt. Pop. of New Goa about 9000. From Marmagao, a seaport to the south of New Goa, a railway runs inland to join the other railways of southern India, and at this port the chief trade of the territory is now carried on.

The territory around Goa belonging to the Portuguese is about 60 miles in length by 30 miles in breadth, and has an area of about 1062 square miles. It is well watered and fertile, the staple crop being rice. About two-thirds of the total population are the descendants of Hindus converted to Christianity on the subjugation of the country by the Portuguese. Goa was taken from the Hindu rajas of Bijanagar by the Bahmani Mohammedan sovereign of the Deccan between 1469 and 1471; and in 1510 was besieged and taken by Albuquerque, who made it the capital of the Portuguese dominions in the East. Goa was in possession of the English from 1807 till 1815. Pop. of territory 495,000.

GOAT (*Capra*), a genus of horned ruminant quadrupeds, distinguished by the horns almost joining at the bases, and bending backwards, the greatest diameter of the base being from before backwards, annular on the surface, and scabrous; eight cutting-teeth in the lower, but none in the upper jaw, and generally a beard on the chin. Goats are of almost endless variety, and it is not certainly known from which the domestic goat is descended, though opinion favours the *C. ægagrus* or wild goat of Western Asia. Like the wild species, it is amazingly swift and agile, climbing the most rugged mountains, and fearlessly browsing at the very edge of the steepest precipices. The female goes five months with young, and commonly brings forth one or two, but sometimes even three or four at a birth. The kids are generally produced early in the spring. The buck has a rank nauseous smell, which proceeds from his skin. Though fond of the summits of bleak and lofty mountains, the goat cannot bear extreme cold. The domestic goat is known in almost all parts of the globe. If we may judge from the expressions of the ancient pastoral poets, goats were formerly tended in Greece and Italy with no less care than sheep. The flesh

is much esteemed by some nations, though it is far inferior to mutton. The milk is excellent, and has been thought peculiarly serviceable for consumptive persons. But the skin is the most valuable part of this animal. It is prepared for a variety of purposes, and takes a dye better than any other skin, and produces the best morocco leather. The tallow of the goat is also an article of considerable importance. It is much purer and finer than that of the ox or sheep, and furnishes much whiter and better candles. The Cashmere goat, as its name indicates, is a native of the Kingdom of Cashmere; it is smaller than the common domestic goat, and has long, silky, fine hair, not curled, as in the Angora goat. This variety has been successfully introduced into France, where it has bred with another variety equally valuable, the Thibet goat. From these animals are procured the materials for the manufacture of Cashmere shawls. (See CASHMERE GOAT.) The Angora goat is also furnished with soft silky hair of a silver-white colour, hanging down in curling locks 8 or 9 inches long. Its horns are in a spiral form, and extend laterally. It is remarkable that not only the goat, but even the sheep and hare of Angora, have longer and softer hair than the same animals in any other part of the world. From the wool of this goat the finest camlets are made. Syria affords a peculiar variety of the goat, of which but little is known. The ears are usually between 1 and 2 feet in length, and are sometimes so troublesome to the animal that the owners are obliged to trim them. This variety appears to have been known to Aristotle. There are several other varieties of the common goat. The pronghorn antelope was formerly referred to the genus *Capra*, but is now placed among the Antelopes. See the illustration at the article UNGULATA.

GOAT-MOTH, a large British insect, the scientific name of which is *Cossus ligniperda*, the type of the Linnæan genus *Cossus*, included in the family Epialidæ or Cossidæ, belonging to the natural order Lepidoptera. The genus is characterized by antennæ at least as long as the thorax, with a row of small lamellar teeth rounded at the ends on the inner side. The larvæ hollow out galleries in the wood of trees, which they first soften by a juice of a strong smell which they secrete. With the sawdust made in the operation they form cocoons, in which the chrysalids are developed, and which are placed near the hole by which the fully-formed insect escapes. The larva of the goat-moth is reddish, about 3 inches in length, and has a plate of a blood-red colour on each ring. It lives three years in the wood of the oak, willow, or elm. The fully-developed insect is ash-coloured, with numerous small black lines on the first pair of wings. The posterior extremity of the thorax is yellow, with a black line. It was formerly supposed that the *cossus* of the Roman epicures was the larva of this moth, but this view is not now generally held.

GOATSUCKER (*Caprimulgus Europœus*). This bird, whose congeners are known in America under the names of *night-hawk*, *whip-poor-will*, &c., is found everywhere in the eastern hemisphere from Siberia to Africa. Like the owl, it is seldom seen in the daytime, unless disturbed, or in dark and gloomy days, when its eyes are not dazzled by the bright rays of the sun. As night insects are its food, namely, moths, gnats, and beetles, it is peculiarly formed to enable it to catch them on the wing. For this purpose nature has bestowed on it a mouth of great comparative size. When the animal flies it is continually open, and has no need of being shut to secure any insect, as it is covered on the interior with a glutinous substance that prevents their escape. There is also a row of bristles, directed downwards, placed along each edge of the upper mandible. This manner of flying with its mouth open is the occasion of that whirring noise which this bird makes while chasing its prey. It arises from the resistance made to the mouth by the air; and is more or less loud, according to the velocity with which the bird moves. When perched, it usually sits lengthwise on a bare twig, with its head lower than its tail, and in this attitude utters a jarring note, whence one of its common names—*night-jar*. Sometimes it utters a weak, plaintive squeak, which it repeats four or five times in succession, which is probably its note of call to its mate. It is solitary in its habits, and is generally seen alone. The middle toe of the foot is long and furnished with a long claw, which has a serrated edge on the inner side. White of Selborne supposes that its foot is useful in taking its prey, as he observed that it frequently puts forth its leg whilst on the wing, and seems to convey something to its mouth. These birds frequent moors and wild heathy tracts abounding in fern; they make no nest, but the female deposits her eggs on the ground; she lays two or three, which are of a dull white, spotted with brown. Montbelliard, who wrote this bird's history for Buffon, states that it no sooner perceives its retreat to be discovered by an enemy than it carefully rolls its eggs to a more secure situation. Its common name of goat-sucker has no other foundation than ignorance and superstition. The colours of this bird, though plain, have a beautiful effect from the elegance of their disposition, consisting of black, white, brown, gray, and ferruginous, disposed in the forms of bars, spots, and streaks. The male is distinguished from the female by an oval white spot near the end of the three first quill-feathers. It is about 10½ inches in length.

GOBELIN MANUFACTORY, a tapestry manufactory at Paris, established by Colbert in 1667, on the site of a previously existing manufactory which had been set up on the banks of the Bièvre, a small stream in the Faubourg St. Marcel, by Gilles Gobelin, a native of Rheims, who was a celebrated dyer in the reign of Francis I. The productions of this establishment excel everything of the kind in Europe. Many celebrated paintings of the old Italian, French, and Spanish schools have, in the most ingenious manner, been transferred to tapestry. Among the more celebrated of these may be mentioned the portrait of Louis XIV., by Rigaud (the original of which is in the Louvre), executed in tapestry by Collin; the Assumption of Titian, a large work 23 feet in height, executed, however, not from Titian's original, but from a copy by Serrur; a head by Nicolas Poussin, copied by Marie Gilbert, &c. The first two of these are to be seen in the Gobelin Gallery. The splendour of the colours and the delicacy of the execution are wonderful, and one can hardly conceive how it is possible, in tapestry, to imitate so nearly the appearance of oil colours. The establishment is carried on at the expense of government.

GOBI, DESERT OF, an immense tract of desert country, occupying nearly the centre of the high table-land of Eastern Asia, between lat. 35° and 45° N., and lon. 90° and 110° E., and extending over a large portion of Mongolia and Chinese Turkestan. By the Chinese it is called *Sha-mo*, that is, 'sand-sea.' Its length is probably about 1000 miles; mean breadth, between 350 and 400 miles; area, 300,000 square miles. It is interrupted in its eastern extremity only by a few spots of pasture and low bushes. Its general elevation is 4220 feet above sea-level, but it is intersected west to east by a depressed valley, called by the Chinese the Sand River. West from it lies the Han-Hai, 'Dry Sea,' a barren plain of shifting sand, blown into high ridges. Wide tracts of this dreary region are

flat and covered with small stones or sand; and widely separated from one another are low hills destitute of wood and water. In summer, which lasts scarcely three months, the heat of the sun is overpowering; but in winter the cold is intense, snow and frost frequently occurring in July and August; indeed no month in the year is entirely free from them. Fierce and bitter winds from the icy regions of the north also prevail. The Desert of Gobi is comprised within one of the 'Rainless Districts' of the earth, and is consequently almost devoid of vegetation. The East Gobi is occupied by different tribes of the Mongolian race, which have numerous herds of camels, horses, and sheep. In the West Gobi are some nomadic tribes of the Turkish Tartar race. This tract is supposed at one time to have been a great inland sea.

GOBY. The family of fishes known as the Gobies (Gobiidæ) is characterized as follows:—Two dorsal fins nearly united into one, the anterior fin having flexible rays, not spinous, as is usual in the Acanthopterygians; the ventral fins are thoracic, and united more or less by their bases; the body is scaly, the head unarmed. There are no stomachal or pancreatic cœca. The branchiostegal rays are five in number. Like the blennies they can live for some time out of water, and use their pectoral fins in progression. The family is very numerous, but does not include any important food fishes. The genus *Gobius* is marked by the ventral fins having the central rays longest, the gradual shortening of these on either side giving the limb the shape of a spear-head. The gobies are among the nest-building fishes. The black goby is very common on the British coasts.

GOD. All theologians and philosophers are agreed that we can have no adequate knowledge or conception of God; still three methods are given by which we can arrive at some idea of the Supreme Being. These are, first, by negation, that is, by abstracting from our idea all imperfection; secondly, by eminence, that is, by including in it every excellence in an infinite degree, which we find in created beings in a finite measure; and thirdly, by causality, that is, by including in it the attribution of power sufficient for the creation and maintenance of every other existence. The enumeration of these three methods is due to a philosopher of the Neo-Platonic school, called Dionysius the Areopagite. It is evident, however, that these three methods are not really distinct, for the first implies the other two. A being who is free from every imperfection must necessarily be endowed in an infinite degree with every conceivable excellence, for the want or limitation of any excellence would be an imperfection; and as power is an excellence, the possession of infinite power is implied in the possession of every excellence in an infinite degree.

Such an idea of God, inadequate though it be, is the highest to which the human intellect can attain; but for that very reason it is not the conception of the Deity which has prevailed at all times and in all places. It is necessary that the mind of man be elevated to a certain standard before it can even approach this idea, and hence we find that uncivilized and uncultivated peoples have at all times believed in deities who are deformed by human imperfections, and whose powers are limited either by inanimate forces or by other deities like themselves. In this article, however, since an account of the polytheistic conceptions of the deity is contained in the article POLYTHEISM, we will confine ourselves to the idea of God in its highest form, and merely give a short summary of the different methods that have been adopted for proving the real existence of a being corresponding to this idea, as well as of the refutations that have been advanced in reply to them; for various and numerous as are the means by which different persons have professed to be able to demonstrate the existence of God, there is not one of them which others have not professed to be able to refute.

The arguments for the existence of God have been divided by Kant into three classes—the ontological, the cosmological, and the physico-teleological; and his division has been very commonly followed by subsequent thinkers. Each of these arguments Kant states and refutes in his Kritik of Pure Reason. The ontological argument starts from the idea of God itself, and professes to demonstrate the existence of God as a necessary consequence from that idea. This form of argument is, in some shape or other, a very old one, but was first fully developed and applied by Anselm, in the eleventh century. The manner in which it was stated by Anselm is this: 'God must be thought of as that being than whom none can be thought greater; but this being the highest and most perfect that we can conceive, may be thought as existing in actuality as well as in thought—that is to say, may be thought as something still greater; therefore God, or what is thought as greatest, must exist not only in thought but in fact.' This argument is one of the most celebrated which have ever been brought forward, and has been the subject of much discussion. It was first advanced by Anselm in his Proslogium, but soon after its appearance a work appeared in refutation of it by Gaunilon, a monk of Marmoutiers, and its refutation has since been taken in hand by Descartes, Kant, and many other thinkers. The replies offered to it are various. First, it is denied that the conception of an object as actually existing is a higher or more perfect conception than that of the same object as existing only in thought. Existence adds nothing to the conception, which is in every respect the same whether it be conceived as existing in the intellect alone or as also existing in actuality. But it is further urged that even if this be granted the argument is logically invalid, and the conclusion ought to be, not that the highest object of thought does also exist in fact, but that it must be thought as existing in fact. And if to this the answer be returned that it is not the conceived existence of the given object of thought which is said to be greater than the object merely as an object of thought, but the real existence affirmed to be greater than the conceived existence, it is again replied that in that case the first object of thought still remains the greatest that can be conceived, that with which it is compared being a real existence, not an object of thought at all, and accordingly not conceived; in which case the inference drawn is wholly unwarranted, since the possibility of any higher conception than that first started has not been demonstrated. The confusion lies in speaking of real existence as opposed to existence in thought, seeing that we cannot speak with any meaning of any object as really existing except it is thought to be so; but it is quite legitimate to employ a merely verbal refutation against a merely verbal argument. A precisely similar argument might be used to show the non-existence of the devil, if we only define the devil as that than which nothing can be thought meaner; for whatever idea we may form of him to answer to this condition, yet we may always conceive the object of our thought as non-existent in reality, which is meaner still, and therefore the devil, although he may exist in thought, cannot exist in reality.

Descartes, while refuting Anselm's form of the ontological argument, revived it himself in another form. Applying the test of truth which he derived from his celebrated formula—'I think, therefore I am,' that whatever we clearly and distinctly perceive to belong to the true and unalterable nature of a thing may be predicated of it, he found on in-

vestigating God that existence belongs to his true and unalterable nature, and therefore may legitimately be predicated of him. He illustrates this by the case of a triangle, of which we are warranted in asserting that it must have three angles, because we clearly and distinctly perceive that property to belong to the true and unalterable nature of a triangle. In refuting this argument Kant enforces the distinction between analytic and synthetic propositions, the former being those in which the predicate asserts of the subject something that is already contained in the idea of the subject, as when we say that a triangle has three angles; and the latter, those in which the predicate asserts something of the subject which is not contained in its idea, as when we affirm the existence of anything, as a table. He then asks whether the proposition that God exists is an analytic or synthetic proposition. If it is analytic, he says that in that case we add nothing to the idea that we have of God already; the proposition is merely an affirmation of what is already known, and can only be true in this sense of a God that is already given as existing. If, on the other hand, the proposition, 'God exists,' is a synthetic one, then it cannot be derived from the idea itself, and the affirmation of it is a mere assumption of the very thing that has to be proved. 'All the pains and trouble,' he concludes, 'of this argument are lost, and a man will no more increase his knowledge by mere ideas than a merchant will increase his means by the addition of a few ciphers to his balance.' A similar argument to this of Descartes was advanced by Leibnitz, which is involved by Kant in the same condemnation.

Another argument was adduced by Descartes to prove the existence of God, which, although not the same with the ontological argument, appears to resemble it. It is called the psychological argument. Like the ontological argument, it starts from the idea of a supreme and perfect being, but it does not assert the objective existence of that being as implied in its idea, but infers such objective existence on the ground that we could have acquired the idea only from the being which corresponds to it. This argument is replied to by Gassendi and others, who deny that we have a clear idea of a supreme and perfect being, or any idea but such as corresponds with the imperfection of our own faculties, and can therefore be readily explained as having arisen from our own nature and circumstances.

After dealing with the ontological argument Kant passes on to the cosmological argument, which starts not from an idea, but from a contingent existence, and infers from it an absolutely necessary being as its cause. To this argument Kant has two objections. First, in accordance with the spirit of his Kritik of Pure Reason, he denies the right to infer from a phenomenal and contingent existence a necessary existence beyond the reach of experience. He denies to the law of causality any validity beyond the phenomenal world, and refuses to admit that the principles of reason authorize us in breaking the chain of phenomenal causes in order to attach it to a necessary being beyond the world of sense. But, secondly, he says that if this inference be allowed we have still reached no God: we know nothing of the attributes of this necessary being, and we can only seek in pure ideas the attributes with which to clothe it, that is to say, the cosmological argument brings us back to the ontological one, and with it must fall.

The argument called the physico-teleological is that which is commonly known as the argument from design, which has been so fully illustrated by Paley in his Natural Theology (a work based on a similar one written by a Dutchman, called Bernard Nieuwentyt). The argument is capable of receiving literally endless illustration, but may nevertheless be stated in a few words. It is simply this, that in nature there are unmistakable evidences of the adaptation of means to ends, which lead us inevitably to the idea of one that planned this adaptation, of God. The eye, for example, is evidently so constructed as to enable us to see, therefore there must have been some one who designed the eye, and that designer is God. This argument, which is recognized by nearly all thinkers as the most convincing and perhaps the best, is yet subjected by Kant to the same criticism as the other two. At best, he says, the legitimate inference is only that there is a world-designer, a builder who gave form to materials already presented to his hand, and if we press the argument any further to prove the existence of a supreme and all-perfect being we find ourselves landed in the cosmological argument, which again lands us, as we have seen, in the ontological argument. This criticism of Kant's is accepted even by many Christian theists, who think that nothing but injury is done to the argument by attempting to prove by it more than it can be legitimately held to do, and therefore appeal to this argument merely to prove the existence of a designer, relying for a knowledge of his attributes upon what he has been pleased to reveal with regard to himself. But this argument has been criticized by others than Kant, who push their criticism to a greater length, by Hume, for example, and the modern Positivists. Hume argues thus: When we see any work of man's art, we immediately infer that there must have been a designer, from our uniform experience of the fact that such works always proceed from designing minds; but the universe, he says, is a singular effect, and we have no experience of how it is made, so that no inference whatever is valid with reference to it. To this several answers have been made. Dugald Stewart replies, that although the universe, taken as a whole, is indeed a singular effect, yet it is not merely from looking at the universe in this way that the inference is made. We see evidences of a designer in the fact that many things are made to follow one another in succession which all conduce to the same end, and similarly many simultaneous events or conditions are so arranged as to bring about a certain result. But this objection does not evade Hume's mode of argument, for as Hume holds that the only thing that legitimates the inference that human works of art have proceeded from a designing mind is our uniform experience that they do thus proceed, these instances appealed to by Dugald Stewart are all merely different examples of one singular or peculiar case, with regard to which we have no experience. Others refute Hume's argument by denying that it is in virtue of experience that we infer from the evidences of design in a particular work the existence of a designer, averring on the contrary that we make the inference by an original necessity of our nature, and as certainly the first time that we see evidences of design as after repeated experiences of it. If this be asserted only with regard to human works of art and human designers, the alleged necessity does not make a like inference necessary from design or adaptation of means to ends in nature to a designer of nature; and if it be asserted with regard to all design, then Hume would seem to have been in a position to deny the reality of the alleged necessity, otherwise he could not have questioned the validity of the argument, upon which he attempts to throw doubts. The Positivists reply to the argument from design by asserting that whenever we pretend to discover design in the works of nature we go beyond the province of the human mind; that

all that the mind can do towards nature is to observe its sequences and co-existences, and that it cannot perceive design in the phenomena which it observes, but that design is something added to the phenomena; that we ought not to say that the eye is made for seeing, but that we see *because* the structure of the eye is such as makes it possible for us to see. The works of nature may, they admit, be the result of design, but whether they are so or not is a question which the human mind, with its present means of knowledge, is unable to determine, and we ought not to pretend to see in phenomena what we in reality can *not* see there.

All the arguments for the existence of God which appeal to the speculative reason may, in Kant's view, be referred to one or other of the heads which we have just treated, the ontological, cosmological, and physico-teleological, and they are all pronounced, as the result of his criticism, unsatisfactory. In this strait Kant turns from speculative reason to practical reason, and bases upon it an argument of his own. Practical reason, he says, imperatively demands that in our practice we should aim at the realization of the supreme good, which is comprised in supreme virtue and supreme felicity. The conditions of nature, however, are opposed to the realization of either the one or the other. Yet practical reason demands that we endeavour to reach both. It must therefore be possible. What prevents us from attaining supreme felicity is that nature does not agree with our objects, and that as active beings we are not the causes of nature. We cannot, therefore, attain supreme felicity by our own wills, and in order that the demands of practical reason may be satisfied there must be some being superior to nature, the common cause both of the natural and the moral world, who can bring both into harmony, and secure to us complete felicity in obeying the moral law. To this argument it has been objected that it has only a subjective force, and cannot prove the objective reality of the being whom it supposes; and that in arguing from the fact of man feeling himself obliged to obey conflicting laws, the only valid inference is that there must be disorder *somewhere*, in which case it may be questioned whether the disorder be not in man himself, and whether all would not be right if he were brought back into harmony with the universe.

Another argument has been adduced for the existence of God, derived from the fact that such a belief is everywhere found to be implanted in the breast of man. This argument is used among others by Cicero, and many thinkers are inclined to give a good deal of weight to it; still it is pronounced by others to be at best only a probable argument, if it may be accepted as valid to prove anything at all. Others argue the existence of God from the manifestations which he has made of himself to men, but these, as well as miracles, it is admitted even by Christian theists, can only be accepted as real by such as previously believed in the divine existence.

GOD, Truce of. See Truce of God.

GODAVARI, a large river in peninsular Hindustan, having its source in the Western Ghauts, about 70 miles north-east of Bombay, near lat. 20° N.; lon. 75° E.; and its embouchure in the Bay of Bengal, lat. 16° 48′ N.; lon. 82° 20′ E.; thus nearly crossing the entire peninsula of Hindustan. Its course is generally south-east, and is in length about 550 to 600 miles. About 50 miles from the sea the river divides into two channels, the most northern of which flows into Coringa Bay. It is only, however, in the rainy season that either of these branches is navigable, and then for small craft only. Before the river divides there are three great obstacles to navigation, caused by three rocky barriers, the first about 330 miles from the mouth of the river and 35 miles in length, the second 75 miles lower down and 14 miles in length, and the third 68 miles lower down, about 90 miles above the place where the river divides, and about 20 miles long. Between 1861 and 1871 large sums of money were expended by the government on an attempt to open up the navigation of the river by canals going round these barriers, but in October of the latter year the attempt was abandoned as involving expenditure which did not give promise of any adequate return.

GODFATHER and GODMOTHER, persons who are sponsors for a child at baptism, who promise to answer for his future conduct, and that he shall follow a life of piety, thus obliging themselves to instruct the child and watch over his conduct. The relation is of high antiquity in the Christian church, and was probably intended to prevent children from being brought up in idolatry, in case the parents died before the children had arrived at years of discretion. By the canon law the relation of godparent and godchild is an impediment of marriage between the persons thus related. Formerly the number of godparents to a child was frequently very large, but the Council of Trent limited the number to one or two; and the ritual of the Church of England requires that for every male child baptized there shall be two godfathers and one godmother, and for every female child one godfather and two godmothers.

GODFREY, Sir Edmund Berry, the magistrate who received the depositions of the infamous Titus Oates with regard to the alleged Popish plot, September, 1678. He was soon after found dead, pierced with his own sword, though evidently not by his own hand. His death was imputed to the resentment of the Papists, and his remains were buried with great pomp, Oct. 31, 1678. See Popish Plot.

GODFREY OF BOUILLON, born, it is said, about 1061, at Baisy, in the Walloon Brabant, near Nivelles, was the son of Eustace II., count of Boulogne and Lens. In 1076 he succeeded his uncle, Godfrey the Hunch-backed, duke of Lower Lorraine, in the duchy of Bouillon. In Germany and Italy he served under the Emperor Henry IV., who was indebted principally to him for the victory over Rodolph, duke of Suabia, at Merseburg. He also distinguished himself by his heroic courage at the siege of Rome. The fame of his exploits procured him, in 1095, the command of one of the armies of the first crusade, that composed of troops collected from Lorraine and Germany. Early in the year 1096 Godfrey, in company with his brothers Baldwin and Eustace, commenced his march, having selected the course of the Danube as his route to Constantinople, the meeting-place of the crusading armies. His march through South Germany was conducted without opposition, but when he came to the frontiers of Hungary the King Koloman refused to allow him a passage through his land, until Godfrey, in a personal interview with the king, concluded a treaty with the latter, in which he gave security that no injury should be done to his land. Godfrey kept faithfully to his word, maintaining perfect discipline among his troops during their passage through the plains of Hungary, and then led his army with equal skill and prudence in a toilsome march through the forests of Bulgaria and Thrace. So great had been the difficulties of the way that it was only a short time before Christmas when he reached Constantinople. Here new delays occurred. The Emperor Alexius Comnenus would not consent to allow the crusaders to cross over the straits into Asia Minor until the leaders had sworn to give up to him all the lands which they should conquer which had previously belonged to the Roman Empire, and to

remain his faithful vassals for all time coming. This Godfrey at first indignantly refused to do, but after a course of hostilities, which lasted over the whole winter and spring, he finally yielded to the demands of Alexius. Hostilities then ceased, and the emperor did all in his power by presents and promises to hasten the departure of the crusaders. On the 1st of May, 1097, they crossed the Bosporus, and began their march on Nice (Nicæa), the capital of the Seljuk prince Kilij Arslan, which they took in June. In July the way to Syria was opened by the victory of Dorylæum (Eski Shehr), in Phrygia, and before the end of 1097 the crusaders encamped before Antioch. The town of Antioch fell into their hands by treachery on the 3d of June, 1098, but the citadel was still in the hands of the enemy, when the crusaders were themselves besieged and reduced to extreme necessity. While they were in this state a Provençal priest, Peter Bartholomew, pretending that he had been favoured with a revelation, instructed them where to find the holy lance, with which Christ had been pierced on the cross, and after some search the priest himself produced a rusted weapon which was believed to be the lance they sought. This circumstance inspired the crusaders with such courage that they repulsed the Turks, and gained a splendid victory. In the following year (July 15, 1099) Godfrey took Jerusalem itself, after a five weeks' siege. The infidels were indiscriminately massacred, notwithstanding the endeavours of Godfrey, whose mildness was equal to his bravery, to put a stop to the slaughter. Eight days after the capture of Jerusalem the leaders of the army elected him king of the city and the territory; but the pious Godfrey would not wear a crown in the place where Christ was crowned with thorns; and he declined the kingly title, contenting himself with that of *duke* and *guardian of the holy sepulchre*. The sultan of Egypt having learned, that of the 300,000 Christians who had assisted in the capture of Antioch only 20,000 now survived, raised an army of 400,000 men for the purpose of expelling them from their new conquests. Godfrey gave him battle in the plain of Ascalon, on which occasion 100,000 men were left dead upon the field. This victory placed him in possession of all the Holy Land, excepting two or three places. Godfrey now turned his attention to the organization of his newly established government. He appointed a patriarch, founded two cathedral chapters, and built a monastery in the Valley of Jehoshaphat. He subsequently gave his new subjects a code of laws, but soon after died, July, 1100, just a year after the capture of Jerusalem. He was buried in the church of the Holy Sepulchre. Tasso's beautiful epic poem sets the character of this great prince and general, whom history has handed down to us as a pattern of piety, bravery, and all princely virtues, in a just light.

GODFREY OF STRASBURG (Gottfrit von Strazsburg), one of the most distinguished of the old German poets, was probably born in Strasburg, but at any rate lived there. He was not, like most of the *Minnesingers* (minstrels) of his age, a noble. He lived in the most flourishing period of the German chivalric poetry, at the end of the twelfth century and beginning of the thirteenth. Besides many lays in the collection of Manesse, we are indebted to him for the great chivalric poem, Tristan und Isolde, derived from the legends of the Round Table, from a Welsh original, but possessing as much originality of character as any other German classical work. For grace, elegance, and vivacity of description, richness of colouring, and melody of versification, the work of Godfrey stands alone in old German literature, and a soft and almost elegiac strain of sentiment pervades his poetry. It was continued by Ulrich of Türheim and Heinrich of Freiberg, &c. There are editions of the poem by Massmann (Leipzig, 1843), Bechstein (Leipzig, 3rd edition, 1890–91), and Golther (Stuttgart, 1888). An excellent translation into modern German is that of Hertz (2nd edition, 1894). Apart from the Tristan, very little of Godfrey's work remains.

GODIVA, the heroine of a remarkable story in early English history. She was the wife of Leofric, a grim earl of Mercia and lord of Coventry in the reign of Edward the Confessor. The inhabitants of Coventry having on one occasion offended their master, he punished them by inflicting so heavy a fine that they were unable to pay it. In their distress they appealed to Lady Godiva to intercede for them, saying that if they paid the fine they must starve. Godiva, who was of a compassionate disposition, and sympathized with the people, agreed to do so, and went to her lord to plead that, for her sake, the tax might be remitted. Leofric, however, only laughed at her, and when she persisted in her entreaties at last said to her, half jocularly and half contemptuously, that he would grant her request if she would ride naked through the town of Coventry. Leofric imagined that this would put an end to her appeals, but Godiva, having first received permission from her lord to fulfil the condition which he had imposed, caused it to be made known on what terms the earl had agreed to relieve the people from the tax, and then proclaimed that on a certain day no one should leave his house before noon, that all windows and other apertures in the houses should be closed, and that no one should even look out until noon was past. She then mounted naked on her palfrey, rode through the town, and returned; and Leofric, in fulfilment of his promise, and in admiration of his wife's heroism, freed the inhabitants from the burdens he had imposed on them. Only one person, the story says, attempted to look out, and he was immediately struck blind. The people of Coventry commemorated this act of devotion on the part of their benefactress by a stained-glass window in the Church of St. Michael's, in one of the niches of which is still to be seen an effigy intended to represent 'Peeping Tom of Coventry,' the man who could not restrain his curiosity when Lady Godiva was passing. They have also long been in the habit of holding a procession at intervals of a few years in honour of Lady Godiva. It was a common practice to open their great fair by such a procession, and an attempt was made to revive the pageant as late as 1883. The ride of Lady Godiva through Coventry has frequently been taken as a subject by artists and poets.

GODMAN, Doctor John D., an American naturalist and medical writer, was born at Annapolis, in Maryland, in 1794, and, having lost his parents at an early age, was bound apprentice to a printer in Baltimore. Disliking his business, he abandoned it after a few years, and, in the autumn of 1813, entered as a sailor boy in the flotilla then stationed in Chesapeake Bay. In 1815 he left the service, and commenced the study of medicine. After lecturing for some time at Baltimore in the room of the professor of anatomy in the University of Maryland, and holding a chair of anatomy for a short time at Cincinnati, he settled in Philadelphia as a physician and private teacher of anatomy, and for some time assisted in editing Dr. Chapman's Medical Journal. Here he acquired an extensive practice, but his health soon began to fail, and after a voyage to the West Indies, which he undertook with the hope of benefiting his health, but which had not the desired effect, he died at Germantown, Pennsylvania, April 17, 1830. His chief work is his

American Natural History, which he completed in 1828. He is also the author of Anatomical Investigations, an Account of some Irregularities of Structure and Morbid Anatomy, Rambles of a Naturalist, &c.

GODMOTHER. See GODFATHER.

GODOLPHIN, SIDNEY, first Earl of Godolphin, born in June, 1645, of an ancient Cornish family, was an opponent of James, Duke of York, and a supporter of Shaftesbury during the exclusion agitation, but nevertheless he continued in office after the accession of James II. On the flight of that monarch, and while the country was yet in suspense, Godolphin voted for a regency, yet was, after the settlement of the crown on William and Mary, made first commissioner of the treasury. In 1695 he was one of the seven lords justices appointed to conduct the government in the absence of the king. During the reign of Anne he was appointed lord high-treasurer of England, and in this office did much to improve the public credit, and check corruption in the administration of the public funds. In 1704 he became a knight companion of the Garter. In 1706 he was made Earl of Godolphin, and four years afterwards was obliged to retire from office. His death took place in 1712. He was a man of great business capacity, careful and judicious in the choice of his instruments, being generally successful in finding men both of ability and integrity; but his treasonable correspondence with James while he held an office of trust under William of Orange is a serious blot upon his own character.

GODOY, MANUEL, Duke of Alcudia, and better known as the *Prince of Peace*, of a noble but decayed family, was born at Badajoz on the 12th of May, 1767. Having set out with his brother Luis Godoy, to push his fortune in the capital, he entered the guards in 1787, and through one of the maids of honour was admitted to the presence of the queen, whom he at once captivated by his handsome person and pleasing manners. He sung well, played the guitar, and was thoroughly versed in all the arts which were in highest repute at the Spanish court. The imbecile king, Charles IV., was as much pleased with him as his spouse, and he was thus established as a favourite. He in consequence did not so much step as vault into the highest places. In 1791 he became adjutant-general of the guards, in 1792 lieutenant-general, Marquis of Alcudia, grandee of Spain of the first class, and prime-minister; and in 1795, as a reward for the part he had taken in concluding peace with France, he was presented with a large and valuable landed estate, and made a knight of the Golden Fleece. It was on this occasion also that he was named by the king Prince of Peace. Other honours and largesses continued to shower upon him, till at last the whole power of the Spanish monarchy was concentrated in his hands. As he used it in the promotion of French more than Spanish interests, he became extremely unpopular, particularly after the British victory at Trafalgar. He endeavoured to recover his popularity by an attempt to break with France; but the result was only to lead Spain still more deeply into the mire, and furnish Napoleon with a plausible pretext for destroying its independence. The popular hatred being now at its height, an outbreak took place in 1808, which nearly cost him his life. He in consequence sought an asylum in France, where he became a tool in the hands of its government, and employed the influence which he still possessed over the Spanish king to induce him to abdicate in May, 1808. Notwithstanding the enormous wealth which he had at one time accumulated, he lived a long time in Paris in poverty, maintained chiefly by a small pension from Louis Philippe. In 1847 fortune began again so far to smile upon him that he was permitted to return to Spain and resume his titles. The larger portion of his domains, however, was irrecoverably lost, and in 1851 he ended his days in obscurity and poverty at the age of eighty-four. He is the author of a work which was published in a French translation made under his supervision by Eeménard, at Paris, 1836–38, in four vols., under the title of Mémoires du Prince de la Paix, Don Manuel Godoy, duc de l'Alcudia.

GOD SAVE THE KING (or QUEEN), the burden and common appellation of a well-known English national song. Concerning the author and the composer opinions differ. It has been asserted that Henry Carey, who lived about the middle of the eighteenth century, was both; but, being ignorant of the rules of composition, employed Dr. Thornton, of Bath, or, according to some, Christopher Smith, Handel's clerk, to correct his rough draught, and add the bass. This story probably gave rise to the assertion that Handel was the composer. It appears to have been first published, together with the air, in the Gentleman's Magazine in 1745, when the landing of the young Stuart called forth expressions of loyalty from the adherents of the reigning family. After Dr. Arne, the composer of another national song (Rule Britannia), had brought it on the stage, it soon became very popular. Since that time the harmony of the song has undoubtedly been improved, but the rhythm is the same as originally. According to a notice in the New Monthly Magazine, vol. iv. page 389, there is a copy of this national song, published without date by Riley and Williams, in which Antony Young, organist in London, is called the author of the air. There is also a story that this national song, as Burney, the author of the History of Music, maintained, was not made for King George; but that, in the older versions, it ran thus, 'God save great James our king;' and Burney adds, that it was originally written and set to music for the Catholic chapel of James II., and no one durst own or sing it after the abdication of James, fearing to incur the penalty of treason, so that the song lay dormant sixty years before it was revived for George II. Another account ascribes the air to John Bull, who was organist to the chapel of Queen Elizabeth in the last years of her reign.

GODWIN, or GODWINE, earl of the West Saxons, an Anglo-Saxon noble, born about the end of the tenth century. He was the son of one Wulfnoth, but there is much uncertainty regarding his lineage. Probably he was of good birth, though there was a widespread (but rather late) story that his origin was humble. This, however, seems to be without foundation. He was strongly suspected of having contrived the murder of Ælfred, the brother of Edward the Confessor. He assisted Edward in ascending the throne, and married to him his daughter Editha. A quarrel afterwards arose between him and his son-in-law, occasioned by the partiality of the latter for Norman favourites, and Godwin in consequence headed a rebellion, but was compelled to submit and quit the kingdom. In 1052, however, he returned with an army, forced Edward to enter into negotiations with him, re-established himself triumphantly in his old supremacy, and caused the expulsion from the kingdom of most of the Norman intruders. He died in April, 1053. He was the father of Harold, the last Saxon king.

GODWIN, MARY, better known by her maiden name of Wollstonecraft, a writer of considerable but eccentric genius, was born in or near London in 1759. Her parents, whose circumstances were humble, afterwards removed to a farm near Beverley, in Yorkshire, where she attended a day-school. In her

twenty-fourth year she set up a school, in conjunction with her sisters, with whom she removed to Newington Green, and wrote a pamphlet, entitled Thoughts on the Education of Daughters. She was subsequently employed for some time as governess in the family of an Irish nobleman; after which she produced Mary, a Fiction; Original Letters from Real Life, and the Female Reader. She was one of the first to answer Burke's Reflections on the French Revolution, which answer was followed by her celebrated Vindication of the Rights of Women. The eccentricity of her theory was equalled by her readiness to put it in practice, which led her first into the indulgence of a romantic but fruitless attachment for the artist Fuseli, though a married man, and into one more intimate with an American of the name of Imlay, whose desertion caused her to attempt suicide. This ardent passion, like the former, was, however, overcome by a succeeding one, the object of which was William Godwin, author of Political Justice, &c. As the bonds of wedlock were deemed a species of slavery in her theory, it was only to legitimize the forthcoming fruits of the union that a marriage between the parties took place. She died in childbed, after being delivered of a daughter, Sept. 10, 1797. Godwin published her life. The history of this woman, of strong but undisciplined powers and passions, does little to advance the credit of the theory on which she acted. Besides the works above mentioned Mrs. Godwin published a Moral and Historical View of the French Revolution, and Letters from Sweden, Norway, and Denmark. See below.

GODWIN, William, a distinguished novelist and political writer, was the son of a Dissenting minister at Wisbeach, in Cambridgeshire, and born there on 3d March, 1756. He was first educated under a private tutor at Norwich, and afterwards at the Dissenters' college of Hoxton, as a student for the ministry. In 1780 he became the minister of a Dissenting chapel at Stowmarket, in Suffolk, but two years later he had a dispute with his flock. In consequence he gave up the ministry and removed to London, where he set himself to gaining his livelihood by literary labours. Shortly after settling in the metropolis he published anonymously his Sketches of History, which met with some success; and he became also a contributor to the Annual Register. In 1793 appeared his celebrated Inquiry concerning Political Justice, and its Influence on General Virtue and Happiness, a work which established his literary reputation, and from its liberal tendencies exposed him to some danger of a prosecution from government, though no actual proceedings were ever taken. The following year he presented himself before the public in a different character by the production of his novel of Caleb Williams, or Things as they Are, which rapidly and deservedly attained an immense popularity. The object of this work was to expose the many abuses then existing in the administration of the law, which the author has effected in the most masterly manner, allowing it may be for a slight tendency to exaggeration. The interest of the story is of the most absorbing sort, and is almost unique of its kind, deriving no aid from the delineation of the passion of love, which commonly plays the most important part in works of fiction. Towards the end of the year in which Caleb Williams was published some of Godwin's friends, Holcroft, Horne Tooke, and others, were brought to trial for high treason, and though he had studiously refrained from connecting himself with any of the political societies of the time, he now came forward with his pen to the assistance of the accused. His Cursory Strictures on Judge Eyre's Charge to the Jury, published in the Morning Chronicle of 2d October, are believed to have contributed materially to the acquittal of his friends. In 1797 he published the Inquirer, a collection of essays on moral and literary subjects; and in April of the same year he married the celebrated Mary Wollstonecraft, with whom he had lived for six months previously, in pursuance of the notions entertained by both against the rite of marriage. The fruit of this union was a daughter, who afterwards became the second wife of the poet Shelley. A memoir of his wife was published by Godwin in 1798, along with her posthumous literary works. In 1799 he published a new novel, St. Leon, the supposed autobiography of a philosopher who has become immortal by discovering the elixir of life. It contains many powerfully written passages, both in point of description and pathos, though it has failed in establishing itself as a standard work, and is now but little read. In 1801 he married a second time; and in 1803 appeared his Life of Chaucer, followed in 1805 by a third novel, Fleetwood, or the New Man of Feeling. About this time Godwin commenced business as a bookseller, and employed himself in the composition of books for children, issued under the name of Edward Baldwin. Among his subsequent works are: Faulkner, a tragedy, published in 1807; an Essay on Sepulchres, in 1808; Mandeville, a novel, in 1817; A Treatise on Population, in reply to Malthus, in 1820; History of the Commonwealth of England, in four vols., from 1824 to 1828; Cloudesley, a novel, in 1830; Thoughts on Man, a volume of essays, in 1831; and Lives of the Necromancers, in 1834. In the latter years of his life Godwin was presented by Lord Grey with a clerkship in the record office, which enabled him to end his days in comfort. He died on 7th April, 1836.

GODWIT (*Limosa*), a genus of birds belonging to the Scolopacidæ or Snipe family, characterized by a very long bill, three times as long as the head, thick and cylindrical at the base, straight or more or less curved upwards throughout the rest of its length, mandibles furrowed on the sides, smooth and blunt at the points; nostrils basal and longitudinal; wings long and pointed; tail short and equal; legs naked above the joint; toes thin, palmated at the base. In winter they are of an ashen-gray colour, with white on the under parts; in spring the head, neck, and breast are red. They frequent marshes, shallow waters, and the sea-shore. There are two species of this bird found in Britain, especially during the period of passage, the Bar-tailed Godwit, or *Limosa rufa*, and the Black-tailed Godwit, or *Limosa melanura*. The former breeds more to the north, and is not so tall as the other. The female of both species is rather larger than the male, and in the *L. melanura* is about 17 inches long. These birds are much esteemed as food, and are brought from Holland in large numbers, and to some extent also from the fens of Lincolnshire, for the London market.

GOES, or Tergoes, a town and port in Holland, in the province of Zeeland, on the island of South Beveland, 16 miles west of Bergen-op-Zoom. It is surrounded with walls protected by a ditch, and has seven gates. It has an old and a new harbour, defended by forts; a considerable commerce, but unimportant manufactures. It is the birth-place of the jurist Jan Ramus, who was born here in 1535. Pop. (1899), 6923.

GOETHE, Johann Wolfgang von, born August 28, 1749, at Frankfort-on-the-Main, where his father, a Doctor of Law and imperial counsellor, was highly respected; died at Weimar, March 22, 1832. Goethe, the greatest modern poet of Germany, has described his own life, in which, with a master hand, he unfolds the secret springs of the human character, and gives us the key to the most important periods

of his life, and consequently to the productions by which they were respectively distinguished. Goethe's father was an admirer of the fine arts, and surrounded by pictures, which early developed in the son the nice discrimination and the active observation for which he was so remarkable. The Seven Years' war broke out when Goethe was eight years old, and Count de Thorane, *lieutenant du roi* of the French army in Germany, was quartered in the house of his father. The count, who was a man of taste, soon gave employment to the artists of Frankfort. Young Goethe was often present at the conversations of the count with the artists respecting the plans of pictures, the way of executing them, &c. These conversations had a great influence upon the mind of the young poet. The count was fond of him, and allowed him to take part freely in the conversations; and some pictures, relating to the story of Joseph, were actually painted from his suggestions. At the same time he learned the French language practically; and a French company, then performing at Frankfort, awakened his taste for dramatic performances. Drawing, music, natural science, the elements of jurisprudence, and the languages, occupied him alternately. To assist his progress in the languages he formed the plan of a novel, in which seven brothers and sisters correspond with each other in different languages. The youngest of these fictitious persons used Jewish-German, which led Goethe to study a little Hebrew, in which he never, indeed, became a great adept, but which, nevertheless, had an influence on him in his childhood, and may have had a tendency to encourage his inclination to oriental poetry in his later years. By his study of Hebrew Goethe became more intimately acquainted with the Old Testament, and the History of Joseph was his first poetical work. His love for spectacles attracted his attention to a puppet-show, and in the beginning of his Wilhelm Meister he undoubtedly took from his own life the motives of Meister's love for this kind of exhibitions. Goethe very early fell in love, and, as often happens in the case of boys of an ardent temperament, with a girl older than himself. Her name was Margaret, the name which Goethe afterwards gave to the mistress of Faust. Though he was then a mere boy, his passion was so violent as to deprive him of sleep and appetite, so that he fell seriously sick. With returning health he acquired a firmer character, and applied himself with more zeal to his preparation for the university. In 1765 he went, by his father's desire, to Leipzig, where Gottsched still lived; but Ernesti and Gellert chiefly attracted his attention. The young poet did not follow any regular course of studies. His mind was always active, but the subjects of his study were regulated by his feelings. German poetry was then in a critical state. It was generally felt that the old bombastic manner must be shaken off before poetry could make any important progress. Precision and conciseness were then the great *desiderata*, and Goethe soon learned to feel their importance. He began at this period, what he practised throughout his life, to embody in a poem, or in a poetical form, whatever delighted or grieved, pleased or displeased him; in a word, whatever occupied his mind intensely; and no one, perhaps, was ever more in need of such an exercise, as his nature continually hurried him from one extreme to another. Several dramatic pieces were projected by him at this period, when he first realized the immense difference between the form and the substance of religion, law, morals, in short, of all the great subjects which most deeply affect the well-being of man. The fine arts were not neglected, and he zealously studied the first authors on this subject. He always had a taste for drawing, and while at Leipzig also attempted engraving. Improper diet and other causes now brought on a disease from which he had hardly recovered when he left Leipzig in 1768. His health was much impaired, and on his return home he was affectionately nursed by a lady named Von Klettenberg, and his conversations and correspondence with her were the origin of Bekenntnisse einer schönen Seele in his Meister. At the same time this connection led him to the study of mystico-alchemical books (the traces of which are so apparent in Faust), and also to chemistry. He was also led, by the reading of several religious works, to construct for himself a strange theological system, of which New Platonism was the groundwork. He subsequently went to the University of Strasburg, to pursue the study of law, according to the wish of his father, but gave, in fact, more attention to the study of chemistry and anatomy than to that of law. At Strasburg he became acquainted with Herder—a decisive circumstance in his life. Herder made him more acquainted with the Italian school of the fine arts, and inspired his mind with views of poetry more congenial to his character than any which he had hitherto conceived. While here, in the immediate presence of the renowned Minster of Strasburg, Goethe wrote a short treatise on Gothic architecture. The treatise contains some views which he afterwards abandoned. Here, on French ground, and so near to the confines of the French language, he shook off all his predisposition for the French character, and Shakspere now began to have a powerful effect upon him. In 1771 he took the degree of Doctor of Jurisprudence, and wrote a dissertation on a legal subject. He then went to Wetzlar, where he found, in his own love for a betrothed lady, and in the fate of a young man named Jerusalem, the subjects for his Werther. The attention of the public was first attracted to him by his Götz von Berlichingen (published 1773). Werther appeared in 1774. Not long after the publication of Werther, Charles Augustus, the hereditary duke of Saxe-Weimar, made the acquaintance of Goethe on a journey, and when in 1775 he took the government into his own hands, he invited Goethe to his court. Goethe accepted the invitation, and on the 7th of November, 1775, arrived at Weimar. Shortly before he had made a tour in Switzerland with the brothers Stolberg. In 1776 he was made privy-councillor of legation, with a seat and vote in the privy-council. In the same year he made a second journey to Switzerland, on this occasion in company with the duke. In 1782 he was made president of the chamber, and ennobled. In 1786 he made a journey to Italy, where he remained two years, visited Sicily, and remained a long time in Rome.

This residence in Italy had the effect of still further developing his artistic powers, by the contemplation of the treasures of art in that country, by intercourse with the society he met there, and by practice. Here his Iphigenia was matured, Egmont finished, and Tasso projected. The first of these was published in 1787, the second in 1788, and the third in 1790. These were the first works of consequence that had appeared from Goethe's pen since the publication of Werther, and they were received with all the more astonishment and delight. They exhibit a mind arrived at its full maturity, and the influence of his Italian residence is seen in the ideality, or devotion to the purely beautiful, which is characteristic of this period of his life. In the same year with Tasso was published the earliest form of the first part of Faust, with the title Dr. Faust, ein Trauerspiel, a poem in a dramatic form, which belongs rather to Goethe's whole life than to any particular period of it. The subject of this work had engaged

the attention of Goethe very early, and continued to occupy his mind during his whole life; and the poem, even in its first form, was the result of many years' intermittent labour. It was made the depository of the author's most general views on the problems of existence; all that is highest and deepest, most beautiful and most touching, in human life is here contained, along with what is tame and commonplace; and it is this universality of content, combined with the never-dying interest belonging to the general conception of the poem, the representation of the perpetual opposition between the demands of materialism and the demands of spiritualism, which makes this drama of Goethe's a true world poem. At the same time that Goethe was engaged in the production of the works of imagination just mentioned, he had been pursuing various other studies of a scientific nature, with as ardent an interest as if these had belonged to his peculiar province. The result of these studies in botany was a work published also in 1790, Versuch die Metamorphose der Pflanzen zu erklären, in which he gives expression to the view, since generally adopted by botanists, that the leaf is the primary form of a plant, and that the whole plant, and its different parts, may all be regarded as variously modified leaves. In the following year (1791) he began to apply himself to optics, and in 1791–92 he published a work on this subject called Beiträge zur Optik. On the 1st of May, 1791, he became director of the court theatre at Weimar. In 1792 he followed his prince during the campaign of the Prussians against the revolutionary party in France, and was present at the battle of Valmy on the 20th of September. From this campaign he returned with a mind partly depressed by the want of success of the army to which he was attached, and partly embittered by all that was going on around. He could not but feel abhorrence towards the violence and excesses of those who took part in the revolution, and yet he was in an equal measure disgusted at the corruption of courts and the insolence of the aristocracy, which had brought it about. In this frame of mind the idea occurred to him of giving expression to his feelings by a modern version of the middle age satire of Reineke Fuchs. This was the work of 1793. The year 1794 is an important epoch in Goethe's life, inasmuch as it was in the summer of that year that he contracted an intimacy with Schiller, which gradually ripened into the warmest friendship, and only ended with the death of the latter in 1805. The two poets had met for the first time at Rudolstadt, on the 7th of September, 1788, but at first they regarded each other with mutual coldness, amounting, on Schiller's part at least, even to aversion, although each acknowledged and esteemed the other's genius. This continued until, at the date just mentioned, Schiller, then living at Jena, not far from Weimar, started a literary periodical called the Horen, to which he invited several of the leading writers in Germany, and among them Goethe, to contribute. Goethe willingly agreed, and at a meeting which took place soon afterwards the poets first learned to understand one another, and ever after the intimacy was kept up by frequent visits and correspondence. This correspondence was afterwards published with the title Briefwechsel zwischen Schiller und Goethe in den Jahren 1794–1805. The friendship between the two poets was in the highest degree beneficial to both. Goethe, to use his own expression, felt his youth renewed, and was stirred up by the enthusiasm of the younger poet to fresh literary activity. Some of his finest ballads appeared in the Horen in the years immediately following. One effect of this friendship was that the peculiarly dramatic genius of Schiller roused afresh Goethe's interest in the stage, and both poets were now united in their endeavours to make the theatre of Weimar the model for all Germany. Schiller produced at this period all his great master-pieces, most of which were first represented on the Weimar stage. In this department of literature the creative power of Goethe would appear not to have been the same as it had been. He produced no original drama, but he translated for the German stage Voltaire's Mahomet and his Tancred. In 1794–96 Goethe published Wilhelm Meister's Lehrjahre, a novel which, with its sequel Wilhelm Meister's Wanderjahre (1821), has become well known to English readers through the translation of Carlyle. His next work of importance was Hermann und Dorothea (1797), a narrative poem, in hexameter verse, the characters of which are taken from humble life. In 1806 Goethe married Christiane Vulpius, with whom he had lived since 1788, and of whom he always spoke with warmth and gratitude for the degree in which she had contributed to his domestic happiness. In 1808 he published another edition of Faust in a considerably altered form. The same year is memorable in Goethe's life on account of an interview which he had with Napoleon, who was then attending the congress at Erfurt. This interview was rendered all the more flattering to Goethe by the fact that Napoleon desired to see him not merely on account of the wide-spread fame which Goethe then enjoyed, but also on account of the personal admiration which he felt for him, and which he expressed in the greeting with which he met him, 'Vous êtes un homme.' In this interview Napoleon expressed particular admiration for the novel of Werther, which he said he had read seven times. In 1809 was published Wahlverwandtschaften, another novel, and in 1810 the Farbenlehre or Theory of Colours, a work in which he had the boldness to oppose the Newtonian theory, and to which Goethe himself attached great importance, although the theory therein promulgated has met with no acceptance among men of science. In 1811 appeared Goethe's autobiography, with the title Aus meinem Leben: Dichtung und Wahrheit; in 1819 the West-östlicher Divan, a remarkable collection of oriental songs and poems. Goethe's last work was the second part of Faust, which was completed on the evening before the last anniversary of his birth-day which he lived to see. This second part of Faust forms a remarkable contrast to the first, and is universally pronounced to be altogether inferior to it, although it shows the same perfect mastery of language and rhythm, and is rich in beautiful passages and expressions. This work was not published till 1833, the year after his death. In the same year in which the second part of Faust was completed (1831) Goethe was greatly gratified by having sent to him on his birth-day by fifteen Englishmen, among them Scott, Wordsworth, Southey, Prof. Wilson, Lockhart, and Carlyle, a seal bearing the inscription Ohne Hast, ohne Rast (without haste, without rest), taken from one of his own poems, as a testimony of their esteem. The seal was accompanied by a complimentary letter composed by Carlyle.

If we survey the variety of the productions of this great man, not only in all branches of poetry, but also in natural science, we cannot help admiring the activity and the versatility of his genius—his many-sidedness. His genius appears most wonderful, if we throw a glance at what German literature was when he found it, and what it is now that he has left it, and how it has been affected by him. Goethe was born at a period when the modern German literature was far from having acquired independence and consistency; and in the different periods of his life it is easy to discover the influence at one time of French

literature, at another of classic literature, &c.; but these influences, though sufficient to destroy the vigour and energy of many a genius, rather served to develop his powers more fully. It cannot be denied, however, that even he sometimes was led astray, as, for instance, in his polished and cold Eugenie. But in what branch has Goethe most excelled? Is it the epic? He enriched German literature with some of the most popular epic productions; but his epic descriptions cannot rival the best descriptive compositions of English literature (which may be partly accounted for from the character of the two languages); nor are the conceptions of his epics of the highest character. Is it the drama? He produced some beautiful dramas, and his Iphigenia will always be considered as a master-piece; but, generally speaking, his dramas do not give us sketches of great, important, or interesting characters, nor the picture of a great action—the two chief points of dramatic poetry; and he stands, in this respect, very far below Shakspere. Nay, he does not even do justice to historical characters, as his Egmont shows. Is it didactic poetry? He wrote several didactic poems, but he cannot be said to have excelled in this branch. Is it the novel? He presented German literature with some novels which will always rank among the best; but their excellence, of which we shall presently speak, is not in the plot, nor particularly in the characters described. In short, what is the prominent feature of Goethe's excellence? We think Goethe must be called, pre-eminently, the *poet of philosophy*. It is the philosophy of life and of individual character pervading his works which places them among the first ever produced. Hence he has been able to devote his powers to all forms of poetry; for the drama was not to him what it was to Shakspere, nor the epic what it was to Ariosto. We do not say that his conceptions are in no degree affected by the dress in which they are clothed, but that the form of poetic composition, which he at any time adopts, remains with him more a matter of form than with those who are pre-eminent in any particular branch. Hence his greatest production is his Faust, emphatically a philosophical poem, which will long remain unrivalled; for it is the best of Goethe's productions in a department for which he seems to have been born. His beautiful songs and shorter poems, elegies, distichs, &c., have the same peculiar character; for though many or most of them cannot be called pre-eminently philosophical, yet they are all tinged with the profound reflections of his philosophical mind, and continually remind us of the deep wells from which our griefs and joys, fears and hopes, spring. The circumstance that there was in Goethe's time in Germany no national life, that no grand ideas affected the whole mass with a common impulse, that there are few historical recollections which are sources of a common pride to the whole nation—all this had a great influence on Goethe. It was one of the reasons of his universality, and also the reason that his genius directed itself to the delineation of the character of the individual man, considered apart from the influences which act so strongly upon the mind in communities more strongly imbued with a common spirit. In this respect he resembles not a little the poets and wise men of the East, who, under a despotism which crushes freedom of action, concentrate their thoughts on the inward man. Goethe, we repeat it, is the most universal poet; thoroughly modern in some of his inimitable songs, in which he gives vent to the tenderest emotions of the heart with a sincerity at times almost childlike; whilst in other productions he exhibits the spirit of ancient literature to a degree which probably no modern poet of any nation has reached, as the resemblance is not merely in the form, but in the very conception of the ideas. The service which Goethe has done to the German language is immense; he has elevated it, and used it with that ease and freedom with which genius always handles its material. The clearness and simplicity of his prose style make it the best model for the imitation of his countrymen. It may, perhaps, be said with truth, that the deficiency of Goethe's productions in great national ideas, such as we find in the poets of other countries, was partly owing to his having passed a great portion of his life at the court of a petty prince. But still his whole organization fitted him to be the observer of individual and of social life in the world around him. His mind had no historical cast, and neither the progress of mankind in different stages of society, nor the great characters who have appeared as representatives of these stages, seem to have excited a powerful interest in him. So, too, his own age seems to have passed by him without exciting in him that interest for either of the great contending parties, which is so strong in minds of a different mould.

The principal sources from which a knowledge of Goethe as an individual may be derived, are the various published correspondences between him and various persons; for example, his letters to his friends at Leipzig in the early period of his life (Leipzig, 1849); his correspondence with Herder (Aus Herder's Nachlass, Frankfort, 1856); with Frau von Stein (Weimar, 1848–51); with Lavater, (Leipzig, 1833); with F. H. Jacobi (Leipzig, 1846); with Merck (Darmstadt, 1835 and 1838, and Leipzig, 1847); with the Gräfin Stolberg (Leipzig, 1839). For the later years of his life the chief source of information is Eckermann's Gespräche mit Goethe (vols. i. and ii. Leipzig, 1836; vol. iii. Magdeburg, 1848). This work has been translated into English by Margaret Fuller Ossoli (Boston, 1839). An admirable biography of Goethe by Lewes, which has obtained wide recognition even in Germany, was published at London in two vols. in 1855. The editions of Goethe's works, both singly and collectively, are very numerous.

GOG AND MAGOG. Ezekiel predicts the destruction of Gog and Magog (ch. xxxviii. and xxxix.) by the Jews, and mention is also made of them in Revelation (ch. xx.) Interpreters have given very different explanations of these terms; but they generally understand them to be symbolical expressions for the heathen nations of Asia, or more particularly for the Tartars or Mongols. Magog is mentioned as the second son of Japheth in Genesis (ch. x. 2).

Gog and Magog are also the names given to two reputed giants of early British history, whose statues are erected in the Guildhall in London. The legend reported by Caxton with reference to these personages bears that they were the last two survivors of the sons of the thirty-three infamous daughters of the Emperor Diocletian, who, having murdered all their husbands, were sent to sea in a ship, and arriving in Britain and cohabiting there with demons, had a number of giants for their offspring. These giants, it is said, were conquered by Brutus, the son of Anthenor of Troy, who brought Gog and Magog prisoners to London, where they were kept chained to the gates of a palace on the site of the Guildhall. When they died their place was taken by effigies of them. Effigies called *Gog* and *Magog* certainly existed in London at a very early period, and they were sometimes brought out and placed on a conspicuous place to welcome a sovereign entering the city, as was done to Henry V. in 1415; Philip and Mary in 1554; and Queen Elizabeth in 1558. The old effigies were burned in the great fire in 1666. They were made of

wicker-work and pasteboard, and used to be carried in the lord-mayor's shows. The present figures of Gog and Magog, which are 14 feet high, were erected in 1708.

GOGGLES, a name for a particular variety of spectacles in which the eyes are protected from dust and other foreign bodies by close-fitting tubular rims. The glasses of goggles may be either plain or coloured, the latter being intended to prevent injury from too great intensity of light. In some kinds of goggles the lenses are very small: these are intended to correct squinting, by compelling the wearer to look straight forward.

GOGOL, Nikolai Vassiljevich, a Russian author and humorist, was the son of a landed proprietor, and born in 1808 in the government of Poltava. From an early period he manifested a great turn for dramatic representation, and even endeavoured to establish himself in the profession of an actor, but his first appearance was unsuccessful, and he now proceeded abroad for a short while. He then returned to St. Petersburg, and after filling a situation in a government office, became successively professor of history in the Patriotic Institute, a private tutor, and, lastly, professor of history in the University of St. Petersburg. In none of these did he continue for any time, and again took up his residence abroad, spending a long period in Italy. He returned ultimately to his native country, and died at Moscow on 21st February, 1852. His works are extremely popular in Russia for their graphic and humorous delineation of everyday life and manners, and more especially Russian country life. Among them are—Evenings at the Farm (1832); Mirgorod, a collection of Tales (1834); the Dead Souls (1842), a satirical novel, depicting the public abuses and barbarism of manners prevalent in the provinces; and The Revisor, a satirical comedy of Russian officialdom.

GOIL, Loch, a picturesque arm of the sea on the west coast of Scotland, in the county of Argyle, stretching 6 miles north-west from Loch Long, and from a quarter to three-quarters of a mile wide. At its upper end is the pretty village of Lochgoilhead.

GOITRE, or Bronchocele, known also in Great Britain as 'Derbyshire neck', a disease endemical in Derbyshire, and to a remarkable extent in Switzerland, some parts of France, and elsewhere. It is defined as a chronic enlargement or hypertrophy of the thyroid gland; and it generally appears as a tumour or swelling, situated on the middle part of the neck in front. It displays no trace of inflammation. Its form varies, but when the whole gland is affected it is generally of an ovoid or spheroidal shape. Sometimes it grows to such an extent as to hang down over the breast; more rarely it extends upwards on each side of the neck as high as the ears. Serious consequences sometimes result when the goitre grows to a great size, or when its increase of volume is towards the interior; thus the voice may be affected by the pressure on the larynx, respiration by the compression of the windpipe, swallowing rendered difficult by that of the œsophagus. Sometimes all the symptoms of suffocation, or of congestion of the brain, make their appearance, when the jugular veins are compressed by the swelling. The growth of the goitre is generally slow; it begins about the age of twelve or fourteen, and enlarges insensibly. Sometimes it disappears for a time and again reappears, and in old age frequently acquires a morbid and more or less dangerous character. Iodine is the best remedy that has yet been discovered for goitre, but when the disease has advanced far it is often incurable. As to its cause many hypotheses have been advanced. Some authorities attribute it to the presence of a large quantity of calcareous salts in the water; others to the absence or diminution of the due quantity of iodine in the water and food of the people, &c. Probably the water has most to do with it.

GOLCONDA, a former kingdom of Hindustan, in the Deccan, subverted by Aurungzebe in 1687, and now a part of Haidarabad, or the territory of the Nizam. The capital of the kingdom, with the same name, situated 7 miles W.N.W. of Haidarabad, is now in ruins, but the fort is used as the Nizam's treasury and as a prison. The diamonds for which Golconda was long celebrated were found elsewhere, being merely cut and polished here.

GOLD (chemical symbol, Au; atomic weight, 187). This metal is distinguished from other common metallic elements by its beautiful characteristic yellow colour, which it preserves untarnished on exposure to the atmosphere under nearly all conditions. Many alloys of copper with zinc, tin, and aluminium have also a more or less golden-yellow colour, and are used as substitutes for and imitations of gold, being sold under various fanciful names, such as Dutch metal, Mannheim gold, Abyssinian gold, &c. Some of the bronzes have also a golden colour. None of these resist atmospheric action like gold, but some are fairly permanent under ordinary conditions. Pure gold has a high metallic lustre, but is inferior in this respect to steel, platinum, and silver. The metal possesses a higher specific gravity than any common metal, but is exceeded in this respect by platinum. The specific gravity varies from 19·2 to 19·4, and the metal is thus 1½ times heavier than lead and nearly twice as heavy as silver, bulk for bulk. Gold melts at 1045° C., being somewhat more infusible than silver and more fusible than copper. It does not melt in a common fire. At high temperatures the metal is sensibly volatile, and in the intense heat of the oxyhydrogen blow-pipe or electric furnace may be vaporized. The vapour is purple.

The pure metal is somewhat harder than lead, but softer than copper, silver, platinum, zinc, or iron. It is consequently too soft, in the pure state, for the purposes to which it is generally applied. For practical application it is alloyed with copper or silver, and both these metals are often present. The former renders the gold redder and the latter paler than its true colour. The proportion of gold contained in an alloy is expressed in degrees of fineness, or as 'carats' and carat grains (4 grains = 1 carat). The fineness is expressed in parts per thousand, for example 916·6, or decimally ·9166. The carat value of the gold is expressed in parts of 24, pure gold being 24 carats fine. Thus 9-carat gold contains 9 parts of pure gold and 15 of a mixture of copper and silver, &c., commonly known as 'alloy'. Sovereign gold consists of 11 parts gold and 1 copper; guinea gold, of 11 parts gold, ½ part of copper, and ½ part of silver. Standard and guinea gold are thus 22 carats fine (the legal standard for coins in the United Kingdom and colonies), and contain only 2 parts of alloy. The German, American, and Italian standard is 21·6 carat, and is composed of 1 part copper and 9 gold. The following table shows the relative amounts of gold and baser metal in alloys commonly employed:—

Carats Fine.	Pure Gold.	Alloy.	Fineness in Thousands.
24	24	—	1000
22	22	2	916·66
21·6	21·6	2·4	900·00
18	18	6	750·00
15	15	9	625·00
12	12	12	500·00
9	9	15	375·00
4	4	20	166·6

The lowest recognized standard is 9 carat, but much gold of inferior quality is worked up into ornaments and commonly sold as 'real gold'. Derby gold is also a common name for this poor material. In the United Kingdom articles of jewelry, plate, &c., are stamped with certain marks known as 'hall-marks' or 'plate-marks', as a guarantee that they have the quality they profess to have. (See PLATE.) Tampering with hall-marked articles is an indictable offence. Many specious imitations of hall-marks are put upon sham jewelry, but always differ in some essential feature. Gold alloys of a red character are frequently 'coloured'. This consists in treating the article chemically in such a manner as to dissolve out the base metal constituting the alloy, leaving a covering of purer gold, paler than the original. For this purpose the articles are boiled with 1 part of salt, 1 of alum, 2 of saltpetre dissolved in 4 parts of water, for 20 minutes. *Rolled gold* is produced by applying thin sheets of gold to a plate of alloy and rolling down the compound sheet.

Pure gold has a tenacity of about 7 tons per square inch, and elongates about 30 per cent before breaking. A wire $\frac{1}{10}$ of an inch thick will support nearly 200 lbs. Its alloys with copper and silver are stronger. Standard gold has a tenacity of 18 tons (Austen), and extends 34 per cent before breaking. At very low temperatures this is greatly increased (Dewar). Gold is the most malleable of metals, and can be reduced to extremely thin leaves by hammering. (See GOLD-BEATING.) Such leaves sometimes do not exceed $\frac{1}{250000}$ of an inch in thickness, and transmit green light, although presenting an unbroken metallic surface. This is best seen by mounting on glass. The extreme thinness and high lustre of the metal have led to its use as an illustration of the extreme divisibility of matter. A particle of gold weighing only $\frac{1}{250000}$ of a grain is readily visible to the naked eye. A grain of gold can be made to cover nearly 80 square inches of surface. The malleability of gold is seriously affected by the presence of minute quantities of arsenic, antimony, bismuth, lead, sulphur, selenium, and tellurium. Of the last 0·2 per cent, and of bismuth 0·5, is sufficient to render the metal crystalline and brittle. Traces of the above elements unfit the metal for gold-beating and coinage. These are removed by passing chlorine gas through the molten metal, or by treating the molten metal with mercuric chloride (corrosive sublimate). By continued hammering the metal is slightly hardened, and must be annealed. Gold surpasses all other metals in respect of ductility. The extreme ductility of the metal is shown by the fact that wires less than $\frac{1}{50000}$ of an inch thick were obtained by Wollaston by encasing a wire of gold in silver and drawing down the compound wire. The silver was dissolved off by treatment with nitric acid. A length of 500 feet of such wire weighs only 1 grain. Gold wire is used for making gold lace (which see). Gold is also extremely flexible and tough. The pure metal breaks with a hackly fracture, but the appearance is greatly affected by impurities.

Chemical Properties.—Gold alloys readily with most metals. It is rapidly attacked by mercury, and dissolves in excess of that metal. If the liquid amalgam be squeezed through wash-leather a yellow pasty mass remains, which may be used in 'wash' or 'fire' gilding. This process, however, has been largely displaced by electro-gilding, in which the bath consists of the double cyanide of gold and potassium, and is used hot. The metal is unattacked by any of the simple acids, save selenic, but dissolves in any mixture in which chlorine, bromine, or iodine is liberated. The common solvent is *aqua regia*, a mixture of 1 part nitric acid and 3 or 4 of hydrochloric acid. The chlorine liberated from this mixture converts the gold into the trichloride, an exceedingly soluble body of high tinctorial power, yielding yellow solutions. In the finely-divided state gold is dissolved by chlorine water, bromine water, and iodine solution or tincture, the trichloride, tribromide, and triodide being produced. It also dissolves in potassium cyanide solutions (in the presence of air) and in cyanogen bromide. These solvents are employed in the extraction of gold from its ores. (See GOLD-MINING in SUPP.) Oxides of gold can be prepared with some difficulty. The monoxide is thrown down when caustic potash is boiled with gold chloride solution to which a little acetate of soda has been added. A trioxide (Au_2O_3), a dioxide (Au_2O_2), and a tetroxide (Au_2O_4) are also known. What is known as *fulminating gold*, Au_2O_3 (NH_3), may be prepared by adding ammonia to a solution of gold chloride or by steeping the hydroxide in ammonia. It is a green or brownish powder, which detonates violently when gently heated or when struck. Two classes of gold salts exist. Of the aurous salts, the principal are sodium auro-sulphite, auro-thiosulphate, the cyanide and potassium auro-cyanide. Of the auric salts, the principal are the trichloride and the chlor-aurates. Gold trichloride crystallizes from solution in dark orange-red crystals, $AuCl_3 2H_2O$. It is extremely soluble in water, and volatilizes at 300° in a stream of chlorine gas, but is decomposed on heating to 200° in air with the formation of the monochloride and chlorine, and, at a higher temperature, of gold. It is soluble in ether, naphtha, and essential oils. The chlor-aurates are combinations of gold chloride with sodium, potassium, and other alkaline chlorides. The best known are $KCl.AuCl_3.2H_2O$, and $NaCl.AuCl_3.2H_2O$, salts commonly sold as gold chloride for photographic purposes. Gold is precipitated from solution by most metals. Iron, copper, and zinc precipitate it readily, generally in a more or less pulverulent form devoid of metallic appearance. Oxalic acid, ferrous sulphate, sulphur dioxide, and sodium sulphite, carbon, grape-sugar, and many organic reducing agents, precipitate the gold from gold chloride. In some cases the metal is so finely divided that it imparts a ruby colour to the liquid and does not settle for months. *Purple of Cassius* is the fine purple pigment produced by treating gold chloride solution with a mixture of tin chlorides, *i.e.* stannous chloride containing a little stannic salt. It is used in glass staining, pottery, and enamel painting, and for colouring artificial gems, imparting a pink, rose, or red colour. The addition of tin chloride to the solution, obtained by treating an ore with aqua regia and boiling off the excess acid, is a delicate test for the presence of gold. Finely-divided gold imparts to pottery and glass a colour varying from pink to ruby. Gold resists chemical action to a greater extent than platinum or any other common metal, and in alloys protects base metals from the action of acids to a remarkable extent. Owing to the high specific gravity of gold (19·3) it is possible to roughly determine the richness of the alloy by taking the specific gravity of the article. This is impossible where platinum (sp. gr. 21·4) is present in the alloy. The specific gravity of standard gold is 17·157, and of 18-carat gold 16·8.

Assay of Gold.—The touchstone is employed to determine approximately the quality of the gold. It is a hard, black, siliceous or flinty slate known also as *Lydian stone*. Basalt and black Wedgwood-ware are also employed. The metal to be examined is rubbed on the stone. Any plating or colouring

being first scraped off), and the streak compared with that made by needles of known composition differing from each other by ½ carat. The streak is also treated with nitric acid and a test acid, and the result of their action observed. Three or more sets of needles are employed, the chief being a gold-copper series, a gold-silver series, and a gold-silver-copper series. Sometimes five sets are employed, in which the proportions of silver and copper are varied. The series to which the article tested belongs is determined by comparison for colour, hardness, and toughness, the latter being inferred from the dryness or greasiness of the streak. The streak is first treated with pure nitric acid (applied with a feather), which is afterwards rubbed off. With brass and other spurious copper alloys the streak is completely and instantly dissolved, while poor gold leaves a very faint impression. Nitric acid does not affect any alloy above 15 carat fine. A test acid consisting of 98 parts nitric acid (sp. gr. 1·34) and 2 of hydrochloric acid (sp. gr. 1·173) is used if the streak has been unaffected by the nitric acid. Gold of 18 carats fine and over is not affected by this mixture *in the cold*. This method of testing is only used when a rough idea of the richness is all that is necessary for valuation purposes.

Accurate assays of gold alloys are made by wrapping a weighed quantity (either 5 grains or 0·5 gramme) in sheet-lead, with sufficient silver to equal three times the weight of pure gold present. Lead to the amount of 34 times the weight of the sample is used for all alloys containing less than 50 per cent of gold, and less for richer alloys. The sample is dropped on to a bone-ash cup (*cupel*) previously heated to full redness in a muffle furnace. The copper and all base metals in the alloy are oxidized, and the oxides dissolved in the molten litharge formed by the oxidation of the lead added. The fused oxides are absorbed by the porous cupel, thus keeping the metallic surface clear, and at the end of the operation only silver and gold remain behind. After cooling, the *button* is rolled into a ribbon, annealed, coiled up, and boiled first in nitric acid of sp. gr. 1·16, and afterwards in nitric acid of sp. gr. 1·26, to dissolve out the silver, and, after washing, the coherent cornet of gold is heated to dull redness in an annealing cup, and weighed. The addition of silver in assaying is known as *inquartation*. It is necessary owing to the protective action exerted by gold on other metals.

World's Production of Gold.—Gold is very widely distributed, smaller or larger quantities being found in nearly every country. The ancients obtained gold from the Spanish Peninsula, Greece, Asia Minor, and India. The Ophir of the Bible has been variously located. Possibly it was in East Africa. In more modern times Peru, Bolivia, Brazil, Chili, Mexico, and other countries of South and Central America furnished immense supplies of gold after the discovery of America until about 1850. By far the greatest discoveries of gold have been made during the nineteenth century. The discovery of the Californian placers in 1848, and of the Australian placers in 1851, produced a mad rush to the diggings. In 1858 gold was found in New Zealand, and in 1861 the Otago district became a large producer. Since then immense developments have taken place. Besides California, Dakota, Montana, Arizona, Colorado, Nevada, Idaho, and others of the United States have furnished, and still furnish, large supplies, and Alaska must also be added. British Columbia is an important source, both alluvial and quartz mining being followed. Canada has also entered the lists as a gold-producer, and the phenomenal discoveries of rich alluvial deposits in the Klondyke region in the Yukon basin still furnish excitement. The rich finds in Western Australia, in the Calgoorlie and Coolgardie districts, have recently placed that colony in the front rank as a gold-producer, while Victoria, South Australia, and New South Wales have long been large gold-producing countries. In Victoria, much energy in the development, more especially of 'deep lead' mining, is being put forth. The Witwatersrand district of the Transvaal has sprung into importance since 1886, and Johannesburg is now perhaps the largest gold-mining centre of the world. Russia is also an important producer, the gold being obtained beyond the Ural Mountains. India also produces a considerable amount. Of the prospective gold-fields the most likely are British Guiana, the 'hinterland' of the Gold Coast, certain parts of China, and possibly East Africa. Gold has been found in several parts of the United Kingdom, principally round Dolgelly, in Merionethshire, in Sutherlandshire, in the Lead Hills, in the Wicklow Mountains and other places in Ireland. The production of gold in recent years is shown in the tables given below. Such figures, however, are all more or less uncertain.

Country.	1896. oz. fine gold.	1897. oz. fine gold.	1899. oz. fine gold.
S. Africa,	2,150.106	2,818,493	3,644,889
Australasia,	2,185,872	2,690,278	3,777,559
Russia,	1,041,794	1,121,511	3,164,603
United States,	2,568,132	2,774,935	3,506,679
Other Countries,	1,874,171	2,075,495	3,081,454
	9,820,075	11,483,712	15,175,184
Value,	£41,713,715	£48,780,511	£64,309,450

The great increase in the Australian yield is due to the activity in Western Australia; in the United States, to Colorado—which now excels California. Canada doubled her output in 1898—the output being 701,459 ozs. This is due to the Klondyke field. The *crude* bullion from the Transvaal in 1898 amounted to 4,545,014 ozs. In the decade 1831–40 the value of the average annual gold production of the world was £2,831,800; from 1841–50, £7,638,800, the California placers being by this time worked. In the period 1851–55 the average annual value was £29,195,400, in 1881–85 only £20,371,777. The phenomenal advance since 1885 is largely due to the development of the Transvaal, but since 1894 the United States, Australia (especially West Australia), and the Klondyke region have greatly contributed to the increase; while the cyanide process for treating tailings has led to more perfect recovery of the metal from the ore treated. This phenomenal output of gold—considered along with the fact that much of the ore treated contains only a few dwts., and in some cases a few grains, to the ton—will give some idea of the enormous amount of capital and energy employed in the search after the precious metal. See GOLD-MINING in SUPP.

GOLD-BEATERS' SKIN, a very tough skin or membrane used in gold-beating (which see), and specially prepared from the outer coat of the cæcum or blind-gut of cattle. The intestines of five hundred cattle are required to make a single packet or 'mould' of gold-beaters' skin. See next article.

GOLD-BEATING, the art of hammering gold into leaves of extreme thinness. For this purpose pure gold is alloyed with small quantities of other metals according to the colour required. Ten colours are recognized: red, pale-red, deep-red, orange, lemon, deep-pale, pale, pale-pale, deep-party, party, besides fine gold. In the deeper colours copper preponderates in the alloy, varying from ½ dwt. to ¾ dwt. per oz., and no silver. The pale ones contain silver varying from a few grains to 1 dwt. per oz.

The middle ones contain from $\frac{3}{4}$ to a little over 1 dwt. of alloy, of which $\frac{2}{3}$ is silver and $\frac{1}{3}$ copper. Ordinary gold-leaf contains about 21 grains of alloy per oz., and is thus nearly 23-carat fine. The operations are conducted as follows:—The metal is melted and cast into ingots, which are rolled out into thin ribands between polished steel rolls. Each ounce of gold is rolled to a length of about 10 feet, the riband being $1\frac{1}{2}$ inch wide and 0·0015 to ·001 inch thick. This is cut up into pieces, each weighing about 6 grains, so that 2 oz.—that is, 'a beating'—yields 160 to 170 such pieces. These are packed between intervening sheets of vellum, some 3 inches square, the surfaces of which have been rubbed over with fine plaster of Paris—*brime*—to prevent the gold from sticking. A number of blank pieces of vellum are placed at the top and bottom of the pile, and the packet is bound with straps of the same material. The *cutch* thus formed is beaten with a hammer weighing from 17 lbs. upwards, or by a power hammer, till the gold has been extended to the size of the parchment sheets. The packet is then unbound, the gold squares each divided into four by a steel knife, and the pieces packeted between sheets of gold-beaters' skin (which see) about $4\frac{1}{2}$ inches square. A number of blank skins are placed at both top and bottom. The 600 to 700 pieces are all put into the same packet, and comprise what is called the *shoder*. The shoder is secured by slipping the pile into a parchment band, and again into a similar one at right angles, and is beaten with a round-faced hammer weighing from 9 to 12 lbs. until the gold has extended across the skins. When the gold has filled the shoder each leaf is divided into four pieces with a strip of bamboo sharpened on the long edge. The 2500 to 2800 pieces thus obtained are packed in three packets between fine gold-beaters' skin 5 inches square. Each of these packets constitutes a 'mould'. A large number of blank skins are placed at either side. The packet is secured as before, and each mould is beaten with the 'finishing' or gold hammer, weighing from 7 to 10 lbs., till the metal extends to the edges of the skins, and in some places flows over. When the beating is finished the mould is opened. Each leaf is then lifted deftly by long wooden tweezers, placed, with a sudden downward movement, on a leather pad dusted with 'brime', and from the central part leaves $3\frac{3}{8}$ inches square are cut by means of two sharpened bamboo strips fastened parallel to each other. The leaves are placed by the tweezers in books of soft paper rubbed over with red ochre, red bole, and 'brime' to prevent the gold from sticking. If the leaf does not lie flat, a sudden puff of breath, well directed in the centre, lays it flat. Each book contains twenty-five leaves. Fine gold is more difficult to deal with than that containing a little alloy, owing to its liability to stick when the leaves touch. It, however, beats equally well. The leaf begins to transmit light when $\frac{1}{150000}$ of an inch thick. Ordinary gold-leaf varies from $\frac{1}{200000}$ to $\frac{1}{250000}$ of an inch thick.

GOLDBERG, a town of Prussia, province of Silesia, on a height above the Katzbach, here crossed by three bridges, 14 miles south-west of Liegnitz. It has extensive woollen manufactures. The place owes its origin and name to the gold-mines which were worked here in very early times, and are said to have been very productive. Pop. (1895), 6626.

GOLD COAST, part of the coast of West Africa, extending about 350 miles along the Gulf of Guinea, between the French Ivory Coast colony and the German colony of Togoland, and now, with Ashantee and other territories as a 'hinterland', forming a British crown colony. This portion of West Africa received its name from the considerable quantity of gold which traders obtained here and which it still produces. European trading settlements and forts were early established here by the French, Portuguese, English, Danes, Dutch, &c. In time the British had forts at Cape Coast Castle, Dixcove, Accra, &c., all belonging to a trading company, but these were transferred to the government of the West African settlements in 1821. Owing to the inconvenience resulting from the fact that the English forts, instead of being all on one part of the coast, alternated with the Dutch ones, a treaty was concluded in 1867 between Holland and Britain, according to which Holland ceded to Britain all the forts to the west of the Sweet River, which enters the sea between Elmina and Cape Coast Castle, while Britain ceded to Holland all those to the east of the same river. The Dutch had thus supremacy over the whole coast from the Sweet River to near the French settlement of Assini in the west, and the British from the same river to the Volta on the east. The Danish forts of Christiansborg, &c., had already been purchased by Britain in 1850. By a new treaty in 1871 the whole of the Dutch settlements and rights were transferred to Britain in 1872, and Britain thus came into the possession of a considerable tract of country, partly, however, only as a protectorate. When the transfer had been made, letters were sent by the British governor to the King of Ashantee, informing him of what had taken place and offering him double the stipend that had been paid by the Dutch, 'to ensure his friendship and good-will', and requesting him at the same time to liberate the captive missionaries which he then happened to have at Coomassie his capital. The King of Ashantee, however, laid claim to the fort of Elmina, and about the beginning of 1873 invaded the British territory, whereupon the home government sent out an expedition under Sir Garnet Wolseley, which burned Coomassie and put an end for the time being to the Ashantee claims. (See ASHANTEE.) Subsequently King Prempeh of Ashantee made himself troublesome, and in 1896 was deposed, a British resident being then settled in Coomassie (Kumasi). In 1900 the Ashantees rose against the British, besieged the governor and garrison in Coomassie, and the rebellion was not put down without severe fighting. Since the recent agreement with Germany in regard to the 'hinterland', the British territory here has now an area of some 100,000 square miles, including Ashantee and the Northern Territories. The colony proper is estimated at 46,000 square miles, with a population of 1,500,000. It is intersected by the Prah, the Volta, and other rivers, and is generally fertile, but the climate is hot, moist, and very unhealthy. The Gold Coast is now organized as a crown colony, with a governor, who resides at Christiansborg beside Accra, an executive and a legislative council. There is a special commissioner for the Northern Territories. The chief towns are Accra, Addah, Elmina, Cape Coast Castle, and Quitta. The staple exports are palm-oil, palm kernels, ivory, and india-rubber, while gold is now worked in many parts. The exports and imports each exceeded £1,000,000 in 1899. Gold is expected to become a much more important product in the immediate future. The government is now doing a good deal to improve the colony in regard to education, sanitation, railway and other communication, &c. A government railway is being constructed from the coast inland; harbour works are also taken in hand, telegraphs set up, &c.

GOLDEN BULL, a name given to several state documents, one of them in particular, important in

the history of the old German Empire, issued by the Emperor Charles IV. and accepted by the diets of Nürnberg and Metz in 1356. Its immediate object was to regulate for all time coming the mode of procedure in the election and coronation of the emperor, and it fixed the number of electors at seven. The best-known original of the Golden Bull is that preserved at Frankfort. See ELECTOR.

GOLDEN-CRESTED WREN, GOLDEN-CRESTED REGULUS, or KINGLET (*Regulus auricapillus*), a beautiful bird belonging to the family Sylviadæ, distinguished by an orange crest. It is the smallest of British birds, being only about 3½ inches in length. The most usual haunts of the golden-crested wren are tall trees, particularly the oak, the yew, and the various species of pine and fir. In these it builds its nest, a very neat and elegant structure, the shape of which varies according to the situation in which it is placed. It is most commonly open at the top, like that of the chaffinch; but sometimes, even under the sheltering boughs of a Norway fir, it is covered with a dome, and has an opening on one side. It is always ingeniously suspended beneath the branch, like those of many tropical birds, being the only instance of the kind amongst the birds of Great Britain. The eggs are nine or ten in number, and are small, round, and white. The golden-crested wren is by no means so shy of the neighbourhood of man as is generally supposed. Though it abounds in forests, yet it equally frequents gardens, occasionally even in the suburbs of large towns, and very often builds close to the house, most commonly in a yew or fir, at the height of 5 to 20 or 30 feet from the ground. It is very fearless of observers, and will allow you to approach within a yard of it, while engaged, as it generally is, in hunting for insects on the stems and branches of trees. Perhaps the best time for watching it is a hot sunny day in summer or autumn. In a still and sultry noon, when not a leaf is stirring, and almost every other bird has retired from the heat of the sun into the shadiest thickets, the little golden-crested wren is to be seen flitting noiselessly from spray to spray, with unwearied activity, in search of its food, paying no attention to any one who happens to be watching it, and never for a moment remaining in a state of rest. Its movements are unlike those of any other bird, except, indeed, the blue-tit—but even his do not equal in lightness and airiness those of this little wren. It flutters over the slenderest twigs like a butterfly—now on one side, now on the other—sometimes above the branch, sometimes beneath, hanging with the head downwards—often at the end of it, suspended in the air by its tiny wings, which it quivers without the slightest sound, so that unless you see it, if it were ever so close to you, you would not be aware of its presence except for the little low chirp which it occasionally emits, and which is more like that of an insect than a bird. In shape and plumage, too, it is superior to most of the feathered inhabitants of our woods and gardens: the latter is a beautiful mixture of green and yellow, with white bars on its wings; and on its head the golden-crest, bordered with black, from which it takes its name. In the spring and summer it sings regularly, beginning about the middle of March, and continuing till the end of July. Its song is very soft and low, like a whisper, and, like that of the grasshopper-lark, is no louder at the distance of one yard than of twenty. During the greater part of the year it haunts tall trees, and never alights on the earth; but in the winter it is frequently seen pecking for insects on the grass or among dead leaves, and even on a heath at some little distance from any tree; and when thus engaged it will let you approach it sufficiently near to hear the little snap of its beak when it has found its prey.—A closely-allied species to the golden-crested wren is the fire-crested wren (*Regulus ignicapillus*). This bird is nearly 4 inches in length, and has a crest of a bright-red colour. It is common in the Belgian Provinces, in France, and in large forests in Germany, and it is sometimes, though rarely, seen also in this country. (See illustration at ORNITHOLOGY.)

GOLDEN FLEECE. See JASON and ARGONAUTS.

GOLDEN FLEECE, ORDER OF THE, and THE THREE GOLDEN FLEECES. See FLEECE.

GOLDEN HORDE, originally the name of the ruling dynasty of the Niuches, in the twelfth century the most powerful of the Mongol tribes, but afterwards extended to all the followers of Genghis Khan, who belonged to this dynasty, and of Batu, the grandson of Genghis Khan, who invaded Europe in the thirteenth century. Under Batu the Golden Horde advanced westwards as far as the plain of Mosi in Hungary, and Liegnitz in Silesia, at both of which bloody battles were fought in 1241. Although the invaders were in both instances victorious, the opposition which they met with was so great that Batu contented himself with what he had already achieved, and retired to the vast steppes of Astrakhan and Saratov, where he founded the empire of Kaptshak, or the Golden Horde, which extended from the banks of the Dniester to the Ural, and from the Black Sea and the Caspian to the mouth of the Kama and the sources of the Khoper. This empire lasted till towards the close of the fifteenth century, when it was overthrown by Ivan III. Vassilievich, the ruler of Russia, who refused to pay the tribute which Russia had hitherto paid to the Golden Horde, and, after long wars, succeeded in wresting from the Mongols the territory that they had conquered about two and a half centuries previously.

GOLDEN LEGEND. See LEGEND.

GOLDEN NUMBER. See EPACT.

GOLDEN-ROD (*Solidago*) is a genus of plants belonging to the natural order Compositæ, containing a great number of species, most of them natives of North America, where their brilliant yellow flowers are very conspicuous in the autumnal months, especially in Canada and the north-east of the United States. They are perennial, chiefly herbaceous, with simple undivided leaves, and bear numerous small flowers, disposed in spikes or panicles. The florets of the ray are about five in number, and yellow, the *S. bicolor* excepted, which has white rays. The dried flowers of the *S. odora*, or sweet-scented golden-rod, form an agreeable substitute for tea. In Europe the different species are cultivated in gardens for ornament. One species, *S. virgaurea*, is common in Britain. Some species found in New Zealand and St. Helena attain to the dimensions of trees.

GOLDEN RULE, the name given by the early arithmeticians to the rule of proportion, or rule of three, on account of its extensive usefulness.

GOLD-FINCH. See FINCH.

GOLD-FISH, the trivial name of a beautiful species of *Cyprinus*, or carp, found in the fresh waters of China, and distinguished for the splendid golden colour of the membrane lying immediately beneath the scales. The *Cyprinus auratus* of naturalists is subject to the most singular variations in colour, being at certain times bright golden orange, and at others bronze-black or silver; in the latter stage of colour it is known as the *silver-fish*. A variety called the *telescope carp*, from its singular form, is distinguished for the broad, expanded, and foliate tail, which gives it a very peculiar appearance. This species is preserved in large ponds, where it breeds, and acquires a size far greater than those introduced into Great Britain. As an article of food they are not used, and are only valued for their beauty and

gentleness. They are very prolific, and are easily bred, requiring scarcely any further attention than that of changing the water frequently. Individuals are sometimes met with which want the dorsal fin, and others which, by the uncommon dilatation of the eyes, appear very much deformed. The *Cyprinus auratus* has been said to inhabit the fresh waters of North America; but in every instance where specimens of this fish have been found in our rivers, they have been traced from the fish-ponds of the neighbourhood, where numbers of them were kept. In length they rarely exceed 9 inches; the body is full, and subfusiform; the scales large; and, as in all the species of this division, the fins are without spinous rays.

GOLD LACE, a fabric woven of silken threads gilt or covered with gilt silver wire. The former kind is the cheaper, but has less brilliancy than the other. The thread is gilt by being steeped in some gummy solution, so as to make the gold-leaf adhere, then wound round a cylinder, on which the gold-leaf is applied to one side of the thread, and from that on to another cylinder in such a manner that the ungilt side of the thread is exposed so that it also may be gilt by a second application of the leaf. The silver gilt wire for covering the thread for making the other kind of gilt lace is made in this way. A silver rod is gilt and burnished, then drawn out, flattened, and drawn out again, so that at last 1 oz. of silver may be drawn into a mile and a quarter of wire, every particle of which has a very fine covering of gold, a covering much thinner than the finest gold-leaf. This process is what is called fibre plating. After being made the gilt silver wire is twisted compactly round the silk threads, which are then ready for being manufactured into lace. The gilt wire is so thin that after being twisted round the thread, the latter has still sufficient flexibility for weaving.

GOLD OF PLEASURE. See CAMELINA.

GOLDONI, CARLO, a celebrated Italian writer of comedies, born at Venice in 1707; died at Paris, Jan. 8, 1793. He early showed a taste for theatrical representations, reading every dramatical production of which he could obtain possession, especially the works of the popular comic poet Cicognini, and, when scarcely eight years of age, he ventured to sketch a comedy, which excited the wonder of his relatives. When his boyhood was past his father, who was a physician then practising at Chiozza, destined him for the medical profession, and took him occasionally to visit his patients. But Goldoni, dissatisfied with this study, obtained permission to study law in Venice. Soon after, however, a relative procured for him a place in the Papal college at the University of Pavia. Here, therefore, Goldoni again found himself transferred to a new world. His compeers in the college were principally young and dissipated abbés. Goldoni followed their example. Jurisprudence was treated as a secondary object, while dancing, horsemanship, fencing, music, and gambling were zealously pursued. Still the youth, eager for knowledge, did not neglect to enrich his mind with useful information. His poetical and rhetorical powers continued to unfold, and procured him many friends; his satirical wit, however, made him disagreeable to many people. On a certain occasion, at the instigation of some persons who afterwards betrayed him, he wrote a satirical piece, in which many individuals of respectable families in Pavia were ridiculed. He was, in consequence, expelled from the college and the city, and he went to Chiozza to ask pardon of his parents. His father now took him to Udine (in Friuli), where Goldoni applied himself more earnestly than in Pavia to study. He, however, committed many youthful follies, and on this account was several times obliged to change his residence, until he became secretary to the vice-chancellor of the criminal court in Chiozza, and afterwards accompanied this officer to Feltre, where, at the age of twenty-two years, he had an appointment, and applied himself with great zeal to his official duties. The theatre was at this time his only recreation. A tolerable troop of players performed in Feltre. But a theatre of amateurs in the governor's palace, in which he made his appearance, was still more attractive to him. He was appointed its director, and not only arranged two operas of Metastasio for exhibition without music, but also wrote two comedies, The Good Father and The Singer, which met with great applause, as did also his performance. His father had, in the meantime, established himself as a physician at Bagnacavallo, in the delegation of Ravenna, and was anxious that his son should live with him. Goldoni consented. But scarcely had he arrived when his father died in 1731, and left his family in embarrassed circumstances. From this time Goldoni lived an unsettled and wandering life, resorting to various means to make a livelihood, but usually living as the companion of strolling players in a continual scene of dissipation and intrigue until 1736, when he married the daughter of a notary in Genoa, and removed to Venice. Here he first began to cultivate that department of dramatic poetry in which he was to excel; namely, description of character and manners, in which he took Molière, whom he began to study about this time, for his model. But the prevailing taste in his native country for masques and extemporaneous comedy was a great obstacle in the way of his design to reform the theatre in this respect, and he often found himself obliged to yield to the habits of the people and the players, among whom the famous harlequin Sacchi and his company were at that time conspicuous in Venice. About 1739 he was appointed Genoese consul in Venice, a station which he certainly filled with ability and diligence. It brought him little or no profit, however, and in 1741 the poet saw himself under the necessity of again retiring from Venice to seek a subsistence elsewhere. He removed with his family in succession to Bologna, Modena, Rimini, Florence, Sienna, and Pisa. At Pisa he was persuaded by the Arcadians, a poetical society in Italy, at whose sessions he was present, to return to the practice of the law. Having suffered some neglect in Pisa he again left the law, and followed a company of players, who adopted him as theatre poet to Mantua. From this place he went to Venice, from which he had been absent five years, and thence to Turin. In 1761 the Italian players invited him to Paris, where many of his pieces met with uncommon applause. By the influence of the dauphiness he obtained the situation of reader and master of the Italian language to the daughters of Louis XV.; but on account of the death of the dauphin, the dauphiness, and the King of Poland, his employment and pension were suspended. At the end of three years a yearly pension of 3600 livres was granted him. At the breaking out of the revolution the poet, now eighty-five years of age, lost his pension, and the decree of the national convention of the 7th of January, 1793, on the motion of Chenier, restoring it, and making up the arrears, found him already in the arms of death. His widow received the arrears and a pension for herself.

Goldoni's merits in reforming the Italian theatre cannot be mistaken. Many of his numerous pieces still retain possession of the stage in his native country, and, in translations, of the stages of foreign countries. Among the numerous editions of his works, that published at Venice in 1788 and 1794–95, in forty-four volumes, is the most complete; and that published

at Florence in fifty-three volumes in 1827 the most elegant. Translations and imitations of some of his works have been made in French, German, and English. Goldoni wrote memoirs of himself in French, in which he also composed two comedies, one of which, Le Bourru bienfaisant, was produced at Fontainebleau and Paris in 1771 with great applause, and has maintained itself on the stage.

GOLDSCHMIDT, Hermann, a German painter and afterwards astronomer, born at Frankfort-on-the-Main in 1802, died at Fontainebleau in 1866. He was the son of a merchant, and in 1832 made a journey to Holland in the interest of his father's firm, but the visits which he made to the museums and galleries in that country caused him to conceive a disgust for commerce, and to form the resolution of becoming a painter. He accordingly proceeded to Munich, where he became a pupil of Schnorr and Cornelius, and then went in 1836 to settle at Paris. There he exhibited a considerable number of pictures, among which may be mentioned: Une femme en costume algérien, Le jeune Florentin, La poésie, La Sibylle de Cumes, L'offrande à Venus, Cléopatre, Vue de Rome, Mort de Roméo et Juliette, &c. From time to time Goldschmidt travelled to England, Italy, and Germany, partly for the benefit of his health, and partly for the sake of finding new subjects for his pictures. In 1847, on the occasion of a visit which he paid to the astronomer Leverrier at the Sorbonne, finding to his surprise that he understood the demonstration by which the professor showed that an eclipse of the moon might be expected that very evening, he suddenly conceived the design of becoming himself an astronomer, and in this new profession he rapidly became known as one of the ablest observers of celestial phenomena. Between 1852 and 1861 he discovered fourteen telescopic planets, namely, Lutetia, Pomona, Atalanta, Harmonia, Daphne, Pales, Doris, Eugenia, Europa, Alexandra, Nysa, Melete, Danaë, and Panope. In 1863, although his sight was then beginning to fail, he discovered six satellites of Sirius hitherto unknown. In the same year he had the good fortune to witness at Fontainebleau the rare phenomenon of paraselenes or false moons, which he described. He made numerous communications to the French Academy on the subject of his astronomical discoveries.

GOLDSMITH, or Silversmith, an artist who makes vessels, utensils, and ornaments in gold and silver. The work is either performed in the mould, or beat out with the hammer or other tool. Many works that have raised figures are cast in a mould, and afterwards polished and finished; plates or dishes of silver or gold are beat out from thin flat plates: and tankards and other vessels of that kind are formed of plates, soldered together, and their mouldings are beat, not cast. The goldsmith makes his own moulds, and for that reason ought to be a good designer, and have a taste in sculpture: he also ought to know enough of metallurgy to be able to assay mixed metals and to mix the alloy. Benvennto Cellini was one of the most celebrated artists in metal that have ever lived.

GOLDSMITH, Oliver, an eminent poet and miscellaneous writer, was born Nov. 10, 1728, at Pallas, in the county of Longford, Ireland, where his father, the Rev. Charles Goldsmith, held the living of Kilkenny West, in connection with the Established Church. In June, 1744, he was entered as a sizar at Trinity College, Dublin. In 1749, shortly after his father's death, he quitted Dublin with the degree of Bachelor, and was advised by an uncle, who had already borne a large part of the expenses of his education, and who always remained his warm friend and helper, to prepare for holy orders. When the requisite two years of probation were over Goldsmith made application to the Bishop of Elphin, but his application was refused. He then became tutor in a family, but soon lost his situation on account of a dispute with the master of the house over a game at cards. After this he thought of sailing for America, but after taking out his passage allowed the vessel to set sail without him. The same uncle who had given him assistance before now gave him £50 to go to Dublin to study law, but he had scarcely arrived at the city when he lost the whole sum in gaming. In spite of his repeated imprudences he was once more succoured by his uncle, who supplied him with means to go to Edinburgh to study medicine. Here he remained eighteen months, during which he acquired some slight knowledge of chemistry and natural history. At the end of this period he removed to Leyden, again at the expense of his uncle. After studying at that university for about a year he left it in Feb. 1755 with only one clean shirt and no money in his pocket to make the tour of Europe on foot, and actually travelled in this way through Flanders, part of France, Germany, Switzerland, and Italy. It was probably at Padua that he took a medical degree, as he remained there six months; but his uncle dying while he was in Italy he was again obliged to travel on foot to England, and reached London in 1756 with a few pence in his pocket. A fellow-collegian, Dr. Sleigh, assisted him, and recommended him as an usher to a school. He remained but a short time in this situation, and then took lodgings in London to follow the profession of an author. He conducted a department in the Monthly Review, wrote essays in the Public Ledger (afterwards published under the title of the Citizen of the World), and a weekly pamphlet, entitled the Bee. In 1761 he was introduced to Dr. Johnson. In 1764 he appeared as a poet by the publication of his Traveller. The celebrity which this poem procured its author was the cause of his introduction to the most eminent literary characters of the day. In 1766 appeared his well known Vicar of Wakefield, which at once secured merited applause. In 1768 his comedy of the Good-natured Man was acted at Covent-Garden with but indifferent success, and he applied to the more certain labour of a Roman History, of which he afterwards published an abridgment. His poetical fame was greatly enhanced by the publication of his Deserted Village in 1770, for which he could hardly be induced to take the proffered recompense of £100, until satisfied that the profits of the bookseller could afford it. In 1771 appeared The Haunch of Venison, a poem, and a History of England in four volumes, based on the works of Rapin, Carte, Smollett, and Hume. In 1773 he produced his comedy of She Stoops to Conquer, which was completely successful. He did not, on this account, neglect compilation, and, besides a Grecian History, he supplied the booksellers with a History of the Earth and Animated Nature, composed out of Buffon and others, in a manner which was both amusing and instructive, although the scientific acquirements of the author were not sufficient to guard against numerous errors. Such was the confidence he had acquired in his skill in compilation, that he was meditating a universal dictionary of the arts and sciences, when a despondency of mind, probably owing to the derangement of his circumstances, brought on a low fever, which terminated his life on the 4th of April, 1774. He was buried with little ceremony in the Temple Church, but a monument was afterwards erected to his memory in Westminster Abbey, with a Latin inscription by Dr. Johnson. The manners of Goldsmith were eccentric, even to absurdity; no writer of his time possessed more genuine humour, or was capable of more poignancy

in marking the foibles of individuals, of which faculty his unfinished poem of Retaliation furnishes a very happy specimen. As a poet, his Traveller and Deserted Village have given him a deserved reputation; and his Vicar of Wakefield is one of the best-known and most esteemed of English novels. His compilations are peculiarly felicitous. It was truly observed in his epitaph by Dr. Johnson, that he left no species of writing untouched, and adorned all to which he applied himself. The standard Life of Goldsmith is that by John Forster.

GOLD WIRE. See GOLD LACE.

GOLF, a game played with clubs and balls on open commons, downs, or links, on which a certain number of small holes have been dug in the ground to receive the balls when played. The distance between two successive holes varies from about 100 to about 500 yards, and the number of holes forming a full 'course' is normally eighteen. Round each hole is a piece of smooth well-kept sward called the 'putting-green', or simply 'the green'. The clubs are used for driving the balls into the holes, and the object of the player is to get his ball into all the holes successively with the fewest possible strokes. Such clubs consist of a head and a long handle, the latter being of wood, preferably hickory, and the former generally of beech or iron. The chief wooden-headed clubs are the *driver* and the *brassy*, the first being used for driving the ball a long distance, and the latter, which is shod with brass, being employed in special situations, as when the ball is in a hollow. The club called the *putter*, used when the ball is near the hole, has the head either of wood or of iron. The iron-headed clubs are the *cleek*, the *iron*, the *mashie*, and the *niblick*, all adapted for special purposes. There are two chief methods of playing the game, known as *match play* and *medal play*. In the former, two players are usually pitted against each other. One of them begins the match by placing his ball on a very small heap of sand known as a *tee*, and driving it as near as possible to the first hole. The other player does the same with his ball, after which the player whose ball is farthest from the hole plays again. They continue thus until both balls have been holed. The player who takes the fewest strokes to do this is said to win the hole and counts one, and if both have taken the same number of strokes the hole is *halved* and neither counts. The course usually has various so-called *kazards* in the form of whin-bushes, ditches, sand-holes or *bunkers*, &c., scattered over it, and much of the interest of the game depends on the skilful play required to avoid these, or get one's ball out when it lands in a difficult spot. In medal play the winner is the player who goes the round of the course in the fewest possible strokes irrespective of whether he had a majority of holes or not. Various modifications of these two modes of scoring are in use. A hole match may be won before the round is completed, as, for instance, when one competitor is four holes ahead with only three still to be played. When one player has a lead equal to the number of holes still unplayed, he is said to be *dormy* that number of holes; thus, a player when *dormy three* has a lead of three after playing the fourth last hole, in which case, though he may not win, he cannot lose. Golf is mentioned in Scottish records at a very early date, and was until a comparatively recent time almost confined to Scotland, but other parts of the United Kingdom now possess many flourishing golf clubs and brilliant players, and the game is played in the British Colonies, and even in some foreign countries to a certain extent. The competitions for the Amateur Championship, the Open Championship, and the Ladies' Championship annually attract large numbers of the best players to the leading golf courses of the three kingdoms. The chief Scottish courses are those at St. Andrews (which is the seat of the most famous club in the kingdom), Musselburgh, Prestwick, Carnoustie, and North Berwick; and of English courses the best are those of Hoylake (near Liverpool), Westward Ho (Devonshire), Wimbledon, and Sandwich.

GOLGOTHA. See CALVARY.

GOLIATH. See GIANTS and DAVID.

GOLIATH-BEETLE, a popular name of beetles of the genus *Goliathus*, belonging to the sub-family Cetoniinæ of the Lamellicornia. They often attain a large size, some species being 4 inches long, and many of them are remarkable for their brilliant coloration. *G. cacicus* is a fine South American species much used as an article of food by the inhabitants of the countries where it occurs.

GOLLNOW, a town of Prussia, in the province of Pomerania, in the government of Stettin, and 14 miles north-east of the town of Stettin. It stands on the right bank of the Ihna, a tributary of the Oder, which is navigable up to this point. The industries comprise agriculture, cattle-raising, &c., and there is a trade in timber. Gollnow was one of the Hanse towns, and has belonged to Prussia since 1720. Pop. (1895), 8179.

GOLOSHES a word introduced into our language from the French *galoche*, which again is derived from the Spanish *galocha*, meaning a wooden shoe or clog. It was formerly applied in England to a kind of wooden clogs with a joint at the instep, and upper leathers like those of very low shoes. The name is now restricted to the well-known overshoes first manufactured in America, and made of vulcanized india-rubber.

GOMARUS AND GOMARISTS. See REFORMED CHURCH.

GOMBROON. See BENDER ABBAS.

GOMMUTI PALM (*Arenga saccharifera*), the tree which yields the substance named gommuti, used for cordage, canvas, and other economical purposes, and which occurs in abundance in the islands of the Indian Archipelago. It affects the hilly districts of the interior rather than the sea-coast, and is cultivated by the inhabitants of that region. This is the only species of Arenga of any note, and it has been called one of the most useful of the palms. It grows to a height of 30 to 40 feet, and bears a dense crown of fronds of rather a sombre aspect. The petioles are very stout, and at the base of these, and completely embracing the trunk, a horsehair-like fibre is produced, which the natives use for thatching their dwellings, making ropes, and ornaments for the arms, legs, and neck. The sweet juice yielded by the palm is fermented, forming the 'toddy' of the natives, and a still larger quantity is employed in the manufacture of sugar. The wine of this palm is also used in the preparation of the celebrated Batavian arack. In Malacca the gommuti is cultivated chiefly for its saccharine juice, which is crystallized into the sugar named jaggery. Sago is likewise produced by this plant equal in quality to that of the Cycas. The fruit is about the size of a medlar, and is yielded in great abundance, a single spadix being more than a load for a man. The fleshy outer covering of the fruit affords a juice possessing stimulating and corrosive properties, causing inflammation when applied to the skin. The Chinese separate the albumen of the seed from this noxious integument, and convert it into a sweetmeat. All the Arengas fruit only once during the term of their existence. The gommuti palm reaches maturity in seven years.

GOMORRAH. See SODOM AND GOMORRAH.

GONAIVES, a town on the west coast of Hayti, on the bay of the same name, 65 miles N.N.W. of Port au Prince. It has an excellent harbour, a naval and military hospital, and a mineral spring. The exports are cotton, coffee, salt, and mahogany. Pop. 18,000.

GONDAR, a town in Africa, once the capital of Abyssinia, situated on a hill of considerable height, surrounded on every side by a deep valley; lat. 12° 51′ N.; lon. 37° 32′ E. On the east side flows the Angerab, on the west the Gaha, and the two after effecting a junction 2 miles south of Gondar, empty themselves into Lake Dembea. According to Poncet, who visited Gondar in 1699, it was then 3 or 4 leagues in circuit, and contained 100 churches. It exhibited nothing of the splendour of a European city. The houses were of only one story, and there were no shops. The trade, which was extensive, was carried on in a vast open plain, where the goods were daily exposed on mats. Gondar now consists only of scattered groups of houses and ruined edifices, separated by wide and dreary wastes. The houses are usually well-built of rough-hewn volcanic stone, but the meaner sort are constructed of hardened clay. The principal quarter lies south-west of the ruined palace of the Abyssinian kings, and is named Debra Birhān, the 'church' or 'hill of light'. The estimates formed by travellers of the population have varied very greatly. It seems to have greatly declined in recent years, for in 1838 it was estimated at from 25,000 to 30,000, while Steudner, in 1862, set it down at 7000, and now it is believed to be about 4000, including a large proportion of clergy, monks, and nuns.

GONDOKORO, a village in Africa, in the Eastern Equatorial region, on the right bank of the Bahr el Abiad, or White Nile, lat. 4° 55′ N.; about 1265 feet above sea-level. It used to be a station of the ivory traders, and was also resorted to by gangs of slave-hunters. In order to put an end to the slave traffic here an expedition was sent out in 1869 by the Egyptian government, under Sir Samuel Baker, who in 1871 formally annexed Gondokoro and the surrounding territories. The place was then named Ismailia, in honour of the viceroy, Ismail Pasha, and was made the chief seat of the Egyptian government of the Upper Nile; but subsequently Lado became the seat of government instead. The country here is now under British supremacy.

GONDOLA, a sort of barge, curiously ornamented, and navigated on the canals of Venice. The middle-sized gondolas are upwards of 30 feet long and 4 broad; they always terminate at each end in a very sharp point, which is raised perpendicularly to the full height of a man. They have a well-furnished cabin amidships. In the days of the republic they were all painted black, and the cabins hung with black cloth, except those of the doge and foreign ambassadors, who only were allowed to have coloured ones. The most striking features of a gondola are portrayed in the following stanza of Byron's Beppo:—

'Didst ever see a gondola? For fear
You should not, I'll describe it you exactly;
'Tis a long covered boat that's common here,
Carved at the prow, built lightly, but compactly,
Rowed by two rowers, each called 'gondolier';
It glides along the water looking blackly,
Just like a coffin clapt in a canoe,
Where none can make out what you say or do.'

The gondoliers formerly sung alternately stanzas of poems, particularly of Tasso's Jerusalem Delivered, though with great changes from the original, to beguile the time.

GONDS, the aboriginal or rather non-Aryan inhabitants of the old territorial division of Hindustan called Gondwana, corresponding pretty nearly to what is now called the Central Provinces. They were at an early period mostly driven out of the more fertile parts of this region by the Aryan Hindu immigrants, and forced to take refuge in the great natural fastness of the Satpura plateau, which stretches for 600 miles from east to west across Central India. The Gonds who remained among the Hindus sank to the level of the lowest class of the population except the despised Kshatriyas. The Gond chiefs who had taken refuge in the inaccessible tracts of the Satpura plateau there maintained their independence for a long period without acquiring any extensive sway. During the fifteenth century, however, a Gond dynasty which had its seat at Kherla attained to a position of greater prominence and power. It first comes into notice in 1398, when it was instigated by the kings of Malwa and Kandeish to invade the Bahmani territory; it disappears from view about 1470. But the greatest development of the power of the Gonds was in the sixteenth, seventeenth, and eighteenth centuries, when three Gond dynasties, those of Garha-Mandla, Deogarh, and Chanda, simultaneously held almost the whole of Gondwana under their sway. This was at the period when the numerous small rival Hindu principalities, which were always desirous of increasing their territory, and thus pushed the Gonds back into the most difficult and sterile regions, were absorbed in the great Mogul Empire, which could afford to despise the power of the native races, and was content if the Gond kings gave a nominal submission to its power. As the Gond dynasties rose with the establishment of the authority of the Mogul Empire over the Hindu principalities, so they declined when its hold on these principalities began to be relaxed. A hitherto unknown branch of the Aryan race called the Mahrattas then appeared and began to make encroachments on the territory held by the Gonds, the result of which was that about the middle of the eighteenth century all the regions that had acknowledged the sway of the Chanda and Deogarh dynasties were absorbed into the dominions of the Bhonsla rajahs of Nagpur. In consequence of the severe blow inflicted on the Mahrattas at Panipat in 1761, the Garha-Mandla dynasty was enabled to maintain itself about a quarter of a century longer; but at last, in 1781, it too was overthrown, and its territory annexed to the Mahratta principality of Sagar. With it ended the independence of the Gonds.

GONFALON, an ensign or standard which used to be borne by the chief magistrates of many Italian cities, as Florence and Lucca. These magistrates were hence called *gonfaloniers*. The title of gonfalonier was also sometimes bestowed by the Roman Catholic Church on persons of the highest distinction, who were hence called gonfaloniers of the church.

GONG, a Chinese instrument of music, a kind of shallow basin, 3 inches deep, made of a copper alloy, and struck with a wooden mallet covered with leather. The sound is very loud.

GONGORA Y ARGOTE, LUIS, a celebrated Spanish poet, was born at Cordova in 1561; died there in 1627. He was educated for the church, and was made chaplain to the king, and a prebendary in the cathedral of Cordova. His works consist chiefly of lyrical poems, in which he excelled, being called by his countrymen the *prince of lyric poets*. His style, however, is often difficult to comprehend, even to the Spaniards themselves, and he has had almost as many censurers as admirers in his own country.

GONIOMETER, an instrument for measuring angles, but more particularly the angles formed by

the faces of crystals. Wollaston's goniometer, which is perhaps the most common, consists of a brass circle graduated in degrees on the edge, and furnished with a vernier, so that angles can be read off correct to one minute. The circle turns upon a horizontal axis, supported by a stand. This axis is in the form of a tube, and contains within it a smaller axis which may be turned round either with or without the axis of the circle as may be required. In order that these axes may be turned with facility, each is furnished with a milled head, by which arrangement, when the small one is held and the large one turned, the circle will move round independently of the small axis, and by holding the large milled head while the smaller is turned, then the smaller axis will move independently of the circle; and the one axis is fitted so tightly into the other that when one milled head is turned round, while the other is untouched, both axes will move together. The crystal to be examined is fastened on a kind of universal joint attached to the end of the smaller axis, capable of being placed in different positions by means of screws, and carried round on the end of the axis. The crystal is attached to the end of the joint by means of wax, and placed in such a position that its edge shall be parallel to the axis of motion. The smaller axis is now turned round, while the eye is kept steadily at about an inch distant until the bar of a window, or some other object, is reflected from the surface of the crystal. The smaller axis is kept in this position, while the circle is turned round so that 0° or 180° shall be set at an index fixed in the stand. The circle is then turned round, along with the smaller axis, until the next side of the crystal comes to the same position as the first; that is, where it reflects the same object to the eye in the same situation as before. The arc passed through by the circle will be the supplement of the angle formed by the two faces of the crystal; but it is so graduated that no calculation is required, the angle itself being pointed out. This instrument is well fitted for measuring the angles of small crystals, and with a little care the measures may be taken with sufficient minuteness for all practical purposes. Mitscherlich's goniometer and Mallard's collimator are improved forms of Wollaston's instrument. Babinet's goniometer, invented to measure indexes of refraction, is similar in principle, and has been improved by Moh and perfected by Groth. Several of the above-mentioned goniometers are provided with telescopes.

GONORRHŒA, a specific contagious inflammation of the male urethra or the female vagina, attended with the secretion of much mucus, mingled with a little pus. This disease is generally communicated in impure and promiscuous sexual intercourse, and usually causes considerable pain. Stricture, gleet, and a sort of rheumatic inflammation of the joints are among the more lasting effects that occasionally follow this. Sometimes a very obstinate form of ophthalmia, known as gonorrhœal ophthalmia, accompanies this disease. Gonorrhœa, though a venereal disease, is now known to be quite distinct from syphilis; in the latter the period of incubation is longer, and the infecting poison attacks the whole system. The treatment of both gonorrhœa and syphilis can be intrusted with safety only to practitioners of known skill and high character.

GONSALVO, in full GONSALVO HERNANDEZ DE CORDOVA Y AGUILAR, Spanish warrior, was born near Cordova in 1453. At the court of Ferdinand and Isabella, Gonsalvo attracted much attention by his personal beauty, his knightly skill, and the magnificence of his apparel and style of living. During the war with Portugal which began in 1475 he made a signal display of valour in the battle of Albuera In the bloody war with Granada, lasting from 1481 to 1492, he took many places by storm, and vanquished the boldest Moors who dared to meet him in single combat. He was selected, in conjunction with the king's secretary, to carry on the difficult and dangerous negotiations with the Moorish king Abu Abdallah (or Boabdil), which resulted in the capitulation of Granada and the termination of Moorish rule in Spain. Ferdinand sent him with 5600 men to assist his relative, Ferdinand II., king of Naples, against the French, who occupied the whole of that kingdom (1495). In less than a year Gonsalvo drove the French over the Neapolitan frontiers, and returned to Spain, where he was engaged in subjecting the Moors in the Alpujarras, when Louis XII. of France renewed the war against Naples. In 1500 Gonsalvo again set sail with a corps of 4300 men, ostensibly to assist the Venetians against the Turks. He delivered Zante and Cephalonia from the infidels, and restored them to Venice. Meanwhile Louis XII. of France and Ferdinand of Spain had agreed by a secret treaty to divide Naples between them, France taking the northern part and Spain the southern, consisting of Apulia and Calabria. Frederick III., who had succeeded his nephew Ferdinand II., unable to cope with the combined forces, retired with his treasures to an island. The French, under the Duke of Nemours, entered Naples, while Gonsalvo secured Calabria, and, according to the articles of the treaty, demanded also Basilicata and Capitanata. To this the French, who considered them as belonging to their part (Abruzzo), would not consent. The result was a war between France and Spain, which was carried on with a variety of fortune, until Gonsalvo, by the victory near Seminara, in 1502, obtained possession of both Calabrias. In 1503 he gained a still more important victory near Cerignola, in consequence of which Abruzzo and Apulia submitted, and Gonsalvo marched into Naples. He then sat down before Gaëta. As the siege was protracted, he gave up the command to Don Pedro Navarro, and advanced to meet the enemy. He defeated the Marquis of Mantua; and on the Garigliano, with 8000 men, obtained a complete victory over 30,000 French, the consequence of which was the fall of Gaëta. The possession of Naples was now secured. Ferdinand bestowed upon him the Duchy of Sessa, and appointed him viceroy of Naples, with unlimited powers. His prosperity, however, raised up powerful enemies against him, whose insinuations so far prevailed with Ferdinand that he recalled him from his post. Ferdinand even went to Naples himself, and took Gonsalvo with him back to Spain, and made him grand-master of the Order of St. Iago. Gonsalvo, dissatisfied with having lost his influence, conspired with the High-constable of Castile against the king, whose prudent measures, however, quelled the insurrection in its very commencement. Gonsalvo retired to his estates in Granada. In 1512 the French again made head in Italy, and in alarm Ferdinand called upon Gonsalvo to take command of an army for the protection of Naples. The flower of Spanish nobility flocked to his standard, and such was the general enthusiasm that the distrustful king commanded him to disband his army. The great captain obeyed, although he understood the king's motive. He died at Granada in 1515.

GONVILLE AND CAIUS COLLEGE, CAMBRIDGE, was founded in 1348 by Edmund Gonville, of Terrington, Norfolk, and endowed for a master and three fellows. The original site was between Free School Lane and the churchyard of St. Botolph's. In 1353 William Bateman, bishop of Norwich, Gon-

ville's executor, established the college where the Gonville Court at present stands, and altered the name to the Hall of the Annunciation of Blessed Mary the Virgin. In 1558 Dr. Caius obtained the royal charter by which all the former foundations were confirmed and his own foundation was established. By this charter the college was thenceforth to be called Gonville and Caius College. New statutes have been given under the provisions of the act 19 and 20 Vict. cap. lxxxviii., by which the college is henceforth to consist of a master, thirty fellows, and thirty-six scholars. The fellowships are all open, and are not vacated by marriage, but terminate generally at the end of ten years from the full standing of M.A. The scholarships are also open; nine are of the value of £60 each, nine of £40, six of £30, and twelve of £20. There are also connected with this college four studentships in medicine, founded by Charles Tancred, each of the annual value of £113, 8s.; and two Harrow scholarships, each worth £52, 10s. a year; and two exhibitions, tenable for four years, each exhibitor at present receiving £10 yearly.

GONZAGA, a town, Kingdom of Italy, in the province of and 15 miles south of Mantua. It was formerly strongly fortified, and still possesses an ancient castle; and has a parish church, nine oratories, and several public offices. Silk is manufactured here; and a large fair for cattle and agricultural produce is held in September. Pop. 15,847.

GONZAGA FAMILY. On the decline of the imperial power in Italy, in the eleventh century, the principal families of Mantua took possession of the government of the place. Among these the house of the Bonacorsi was the most powerful during forty years, until the house of Gonzaga rose to eminence. Aug. 14, 1328, Ludovico (or Luigi) Gonzaga assumed the sovereignty after his sons, inflamed by private revenge, had taken possession of Mantua with 800 foot soldiers and 500 horsemen, slain Passerino de' Bonacorsi, the chief of the city, on the field of battle, and banished his followers. The Emperor Louis of Bavaria then appointed Ludovico the imperial vicegerent. He died in 1360, aged ninety-three. Among his descendants, Gian Francesco Gonzaga, in 1432, obtained possession of the city, with its territory, under the title of a marquisate, as a fief from the Emperor Sigismund. After that time the house of Gonzaga was divided into several branches, from which sprang many celebrated individuals. With Vincenzo II. the reigning line became extinct in 1627. The next heir would have been the Duke of Nevers, Charles I. of Gongaza, but the Duke of Guastalla, Ferdinand II., who was one degree more remote, laid claim to the whole inheritance, and Charles Emanuel, duke of Savoy, claimed Montferrat. It was evident that the house of Nevers had a legal right, for Louis, duke of Nevers, father of Charles I., was brother of Francis III., grandfather of the duke, and by going to France did not renounce his claim to the succession. France, Venice, and the pope supported him; for all three desired to see an end of the overbearing influence of the Spanish-Austrian power. Spain and Austria, on the other hand, supported the groundless claims of the Duke of Savoy, whence arose a war concerning the right of succession to Mantua, which finally ended according to the wishes of Richelieu; for the emperor was obliged to invest Charles, duke of Nevers, with Mantua and Montferrat. He obtained peaceful possession of them in 1631. His grandson, Charles III. (Charles II. died in 1631, during his father's lifetime), succeeded him in 1637, and during his reign the principality obtained full independence. He died in 1665. His son and successor, Charles IV., received a French garrison into Mantua, and engaged on the side of France in the contest which grew out of the Spanish succession. On this account the Emperor Joseph I. declared him under the ban of the empire. He died at Padua in 1708. Austria remained in possession of his territory, and Montferrat was transferred to Savoy. Many persons of this family have obtained military renown. Others have been conspicuous for their love of the arts and sciences. Ludovico Gonzaga sent Pietro Crema with letters and a large sum of money to France, in order to persuade Petrarch to come to him. Another Ludovico Gonzaga, who died about 1549, was a poet. Cæsar, in 1565, erected the academy Degl'invaghiti; and others of the family founded galleries of paintings and antiquities. Giulio Romano, under their patronage, established an extensive school for painting, and many celebrated artists received from them support and honour. Lucretia Gonzaga, the unfortunate wife of Paolo Manfrone, left many letters, which have been collected and published (1552, which Haym, however, ascribes to Hortensio Landi). Among those who have obtained renown by their influence in state affairs Louisa Maria, the daughter of Duke Charles, is conspicuous. She was married successively to Ladislaus and Casimir, kings of Poland, and died in 1667. Her sister Anna, the wife of the Prince Palatine Edward, for some time played an important part at the French court. She died at Paris in 1684, aged sixty-eight years, and from the manuscripts which she left at her death the interesting Mémoires d'Anne de Gonzagues were compiled and published (London and Paris, 1786).

GOOD, John Mason, a physician, poet, and philological writer, was the son of a Dissenting minister, and was born at Epping, in Essex, in 1764. He was apprenticed to a surgeon at Gosport, and in 1784 engaged in practice at Sudbury. In 1793 he removed to London, where he carried on business for several years as a surgeon and apothecary. In 1810 and the two following years he delivered physiological lectures at the Surrey Institution, which were afterwards published. Having obtained a diploma from the University of Aberdeen, he commenced physician in 1820, and continued to practise in that capacity till his death, January 2, 1827. His principal works are—Memoirs of the Life and Writings of Dr. Alexander Geddes (1803, 8vo); Translations of Solomon's Song and the Book of Job; a translation of Lucretius, On the Nature of Things (1805, two vols. 4to); Medical Technology (1810, 8vo); A Physiological System of Nosology (1817, 8vo); The Study of Medicine (1822, four vols. 8vo); and The Book of Nature (1826, three vols. 8vo).

GOOD-CONDUCT PAY, a pecuniary reward to corporals and privates in the British army for good conduct. The amount awarded at one time is a penny a day, with one white chevron on the arm as a badge of distinction. The first penny is granted after two years' service, during which the soldier has not incurred any punishment, the second after six years, the third after twelve years, the fourth after eighteen years, the fifth after twenty-three years, and the sixth after twenty-eight years' service. Sergeants do not obtain good-conduct pay; but some years since an addition of twopence per day has been given in lieu thereof. A sum not exceeding £4400 a year is distributed among sergeants of long standing and conduct in the shape of annuities not exceeding £20 each. Good-conduct pay and badges are also awarded in the navy to seamen, but the grant is limited to threepence a day.

GOOD FRIDAY. See Friday (Good).

GOODRICH, Samuel Griswold, better known under the assumed name of *Peter Parley*, was born at Ridgefield, in Connecticut, United States, on 19th

August, 1793. He commenced life as a publisher in Hartford, and established himself in 1824 as a publisher in Boston. He edited here, from 1828 to 1842, The Token, an annual to which he contributed several tales and poems, and in which also appeared some of Hawthorne's Twice-told Tales. His famous Peter Parley series of popular and juvenile books was begun soon after his removal to Boston, and gradually extended to more than 116 volumes, comprising geographies, histories, travels, stories, and various illustrations of the arts and sciences. The geniality of these, and the admirable manner in which the author enlisted the sympathies of children, procured for them an immense success, which led to the issue of some spurious books under the name of Peter Parley. In 1837 Mr. Goodrich published a collection entitled The Outcast, and other poems; and in 1838 an ethical and educational work entitled Fireside Education. In 1841 appeared a selection from his various contributions to annuals and magazines under the name of Sketches from a Student's Window; and in 1857 Recollections of a Lifetime, a most entertaining account of his own history and that of his contemporaries. Merry's Museum and Parley's Magazine were conducted by him from 1841 to 1854. Under Fillmore's presidency he acted as American consul at Paris, and published there in French a treatise on American Geography and History. The last work from his pen was the Illustrated Natural History of the Animal Kingdom (two vols. 8vo, 1859). He expired suddenly of an affection of the heart on May 9, 1860.

GOODS AND CHATTELS, the legal and popular denomination for personal property as distinguished from things real, or lands, tenements, or hereditaments. The corresponding Scotch phrase is *goods and gear*.

GOOD-WILL, the benefit derived from a business beyond the mere value of the capital, stock, funds, or property employed in it, in consequence of the general public patronage and encouragement which it receives from constant and habitual customers. It is legally considered a subject of sale along with the stock, premises, fixtures, trade debts, &c. It is usual for the seller to enter into an express covenant not to carry on a business of the same kind at some specified moderate distance from the place where the purchaser resides, and if he breaks the covenant he is liable to an action for damages.

GOODWIN SANDS, dangerous English sandbanks about 4 or 5 miles off the east coast of Kent, the intervening channel forming the well-known roadstead called the Downs. Their entire length, north to south, is about 10 miles; breadth, varying from 1½ mile to 3 miles; and in many places they are dry at low water. They are divided into two parts by a narrow channel called the Swash, navigable by small boats. Four light-vessels, with lights visible 10 miles off, mark the limits of the sands. These are the North Sand Head, the South Sand Head, the Gull Stream, and the East Goodwin. Various buoys also serve to warn ships off the sands. According to tradition these sands formed at one time part of the Kentish land belonging to Earl Goodwin, whence their name; and were submerged in the year 1099—the sea having broken through the wall by which they had been previously protected from its incursions. Many shipwrecks have taken place here, the most disastrous being that of November 26, 1703, in which 13 men-of-war, with 1200 persons, were lost.

GOOLE, a seaport and market-town of England, in Yorkshire (West Riding), pleasantly situated on the right bank of the Ouse, near the junction of the river Don, or Dutch River, 25½ miles west by south of Hull. The Don is here crossed by a handsome iron bridge. Old Goole, situated to the south of the Don along the banks of the Ouse, is irregularly built; but the new town, on the left bank of the Don, has regular streets, with many fine shops, houses, and other buildings. It has several modern churches and chapels; a fine new post-office (1892); a court-house, of red brick; a fine bank, built in Renaissance style of brick and terra-cotta; a new market-hall; a grammar-school, &c. The harbour, consisting of a basin 250 feet long and 200 wide, is situated near the junction of the Don with the Ouse, and communicates with the latter river by two locks, one of which admits vessels of over 300 tons burden. Among the wet docks are the Ship Dock, the Railway Dock, the Stanhope Dock, the Steamship Dock, and the Aldam Dock, all of which have a depth of from 18 to 25 feet of water; and there is a graving and a barge dock. The Ouse has been greatly improved in recent years below Goole. Goole is the eastern terminus of a branch of the Lancashire and Yorkshire Railway, and it is also a station on the North-Eastern Railway. The Knottingley and Goole Canal connects the Ouse with the Aire. The exports of Goole amount to more than £6,500,000 in value per annum, and comprise machinery, woollen and worsted yarn and manufactures, cotton yarn and manufactures, steel, coal, coke, &c. It also does a very large import trade in sugar, wool, fruit, linen yarn, iron manufactures, &c. Its manufacturing industry is growing. Pop. (1891), 15,416; (1901), 16,576.

GOORKHAS, a tribe of northern Hindustan, named from the village of Goorkha in Nepaul, formerly the capital of the Goorkhas, before the formation of the present Kingdom of Nepaul. The Goorkhas are the mountaineers of Nepaul, with whom a good understanding with the British exists. They now freely enter the native army, and are amongst the most faithful and courageous of the Indian troops, having particularly distinguished themselves in the battles on the Satlej in 1845–46, during the mutiny of 1857, in the war with Afghanistan in 1878–79, in the short Egyptian campaign of 1882, and subsequently. Besides their rifle they carry a formidable short bent sword called a *kookree*, with the edge on the inside of the bend, with which at close quarters they do dreadful execution.

GOOSANDER (*Mergus merganser*), a web-footed bird of the same genus with those commonly called Mergansers, and the largest of the British species. It is a handsome bird, exceeding 2 feet in length; the head and upper parts of the neck are deep, shining green, with a sort of tuft on the back of the neck. The back is black, fading to dark gray near the tail; the wing-coverts are white, as is the front of the wing, the primaries being black. The lower part of the neck, the breast, and abdomen are soft, warm buff; the bill, which is serrated, is scarlet, and the legs reddish orange. In the female the head and neck are reddish brown, and the back gray. The nest is placed near water, under the shelter of long grass or in the hollow of a decayed tree, and is made of grasses and roots, and lined with down. The eggs are generally six or seven in number, and are of a very pale buff colour. The bird is a native of the Arctic regions, extending into the temperate parts of Europe, Asia, and America. In the southern parts of Britain it is found only in the winter months, November to March. Some few birds, however, may be seen throughout the whole year. The flesh is rank and coarse. See the illustration at ORNITHOLOGY.

GOOSE. The geese form the sub-family Anserinæ (L. *anser*, goose), of the family Anatidæ, among swimming birds, and are distinguished from the ducks, which belong to the same family, chiefly by having longer and stronger legs, and comparatively shorter wings. The genus *Anser* is the principal. The common goose, whose domestication is much less ancient and complete than that of the common fowl, is believed to be derived from the *A. cinereus* (*A. ferus*), or Gray-lag Goose, which at one time bred commonly in the fenny districts of England, but is now comparatively rare in this country, though it stills breeds in some localities in Scotland and the islands. Domestication has produced sundry varieties; this state has also greatly added to the fecundity of this bird, and has changed the plumage to a much lighter hue—often to pure white. The goose is common in poultry-yards everywhere, and in some localities is kept in great flocks. The food largely consists of grass and herbage. Geese are valuable not only for their eggs and flesh, but also for their quills and other feathers. They are often specially fattened for the table. The liver of a fat goose is often larger than all the other viscera. The celebrated *pâtés de foie gras* of Strasburg are made of goose livers, which are brought to a state of abnormal enlargement by keeping the birds in an apartment with a high temperature and cramming them with food. Flocks of wild geese in changing their quarters fly regularly in two lines forming a sort of wedge or V, with the point foremost, an old gander being usually stationed here. Among the principal species of geese are the following:—

The *Snow-goose* (*A.* or *Chen hyperboreus*) of North America.—Plumage snow-white, except the primary quills, which are black. The bill of this bird is very typical, the edges having numerous prominent indentations or strong teeth on each side. The inside or concavity of the upper mandible has also seven rows of strong, projecting teeth, and the tongue, which is horny at the extremity, is armed on each side with thirteen long and sharp bony teeth. The flesh of this species is excellent. The *Laughing* or *White-fronted Goose* (*A. albifrons*).—Body brownish; beneath white varied with black; bill and feet orange. This species inhabits the northern parts of both continents, and migrates to the more temperate climates during the winter, though it rarely comes as far south as the middle states of America or Italy. It is a regular winter visitor to the British Islands. The *Bean-goose* (*A. segetum*).—Dark cinereous; beneath whitish; folded wings longer than the tail; bill long, black and orange. This species is also common to both continents; in America it is scarcely ever seen as far south as the northern states, though in Europe its migrations are more extensive. It is a common winter visitor in Britain, feeding upon marsh grasses, growing corn, &c. The *Canada-goose* (*A.* or *Bernicla Canadensis*).—Dark ash-coloured; head, neck, and tail black; cheeks and throat white; bill and feet black. The bill is longer than the head; it has inconspicuous lamellæ; and the base is covered with wrinkled skin. This is the common wild goose of the United States, and is known in every part of North America. It is also found in Europe, where it has been introduced by man. In America this goose is much esteemed for the table, and is shot in great numbers. It has long been domesticated, and readily pairs with the common goose. When in good order it weighs from 10 to 12, and sometimes 14 lbs. The *Bernicle Goose* (*A.* or *Bernicla leucopsis*) and the *Brent-goose* (*A. bernicla* or *Bernicla brenta*) are common British and American species. They belong to the geese known as sea-geese, from their frequenting chiefly salt water, and the latter is specially marine in its habitat. (See BRENT-GOOSE.) There are various other species. The largest of all is the Chinese or swan-goose (*Cygnopsis cygnoides*), which is now not uncommon in Britain and breeds readily with the common species.

GOOSEBERRY (*Ribes grossularia*), a low, branching shrub, growing wild in Siberia and the north of Europe, forming along with the currants the family Grossulariaceæ or Ribesiaceæ, or, according to others, the sub-family Ribesieæ of Saxifrageaceæ. The branches are armed with numerous prickles, and bear small rounded three- to five-lobed leaves and inconspicuous flowers. The fruit attains a larger size and higher flavour in some of the cultivated varieties. In England, if not a native, it is now naturalized in various places, and grows wild in ruins and in woods. It is extensively cultivated in Lancashire, and in the northern counties of Scotland. The Scotch berries do not attain the size of the English, but are far superior in point of flavour. Gooseberries are of various colours—white, yellow, green, and red. The yellow berries have in general a more rich and vinous taste than the white, and are therefore the best for the dessert and for being fermented into wine. When the fruit is choice and well picked, and when the wine is properly made, it often puzzles an unpractised taste to distinguish the produce of the yellow gooseberry from champagne. It has the flavour and colour, and it mantles like the best of the foreign wines, and is indeed often sold for such. Generally speaking, the green gooseberries are inferior to the yellow, and even to the white. When the green is deep and pure, sweetness seems to be the characteristic. The red gooseberries are very various in flavour, but are commonly more acid than the others, yet some of the older and smaller red sorts are very sweet. Gooseberries are of very easy culture; they may be raised from slips, which is the usual mode of perpetuating varieties; new varieties are raised from seed. A moist, soft soil is most favourable. The bushes require a pruning twice a year. The plant of four years old produces the largest and finest fruit; afterwards the fruit becomes smaller, but increases in quantity. Many insects attack the plant, especially the caterpillars of the magpie moth and the gooseberry saw-fly. The best preventive is to hand-pick the bushes early in the season and destroy all the eggs and flies that can be found. Digging up the earth about the roots of the bushes, especially in autumn, is also advisable, as the larvæ bury themselves in the soil, and sprinkling with flowers of sulphur, lime-water, and other fluids has been recommended. Several species are indigenous to the northern and mountainous parts of the United States, one of which bears small purple berries of an agreeable flavour, and is not unfrequently met with in American gardens. In England the gooseberry was early a cultivated fruit, and is mentioned as such by Tusser, a poet of the age of Henry VIII. In France it is neglected; in Italy and Spain it is scarcely known, those countries being too warm.

GOOSEFOOT. See CHENOPODIUM.

GOPHER-WOOD, the wood of which Noah's ark was built, and which modern authorities are inclined to regard as cedar.

GÖPPINGEN, a town of Würtemberg, 22 miles E.S.E. of Stuttgart; contains several churches, a town-house, schools, post-office, old castle, and hospital. Its manufactures comprise machinery, cotton, metal-wares, &c. Pop. (1895), 16,183; (1900), 19,384.

GORAKHPUR, a town of Hindustan, in the United Provinces, in the division of Benares, capital of the district of same name, on the left bank

of the Rapti, which is here a fine navigable river. It is very indifferently built, and has no public buildings of any consequence, but carries on a good trade. Pop. in 1901, 63,059.—The district has an area of 4585 square miles, is generally flat, and moderately fertile. Pop. 2,617,120.

GORDIACEA. See NEMATELMIA.

GORDIAN KNOT. See GORDIUS.

GORDIANUS, M. ANTONIUS, the name of three Roman emperors, father, son, and grandson. The first was a man distinguished for intellectual and moral excellence, and had governed Africa for many years, when he was proclaimed emperor at the age of eighty in 238 A.D. He associated his son with him in the empire, but they had not held the dignity two months when the son was killed in fighting against an officer of the rival emperor Maximinus, and the father, in an agony of grief, died by his own hand. The grandson was proclaimed emperor by the soldiers in Rome, 238 A.D., although he was not more than fifteen years of age. He reigned six years, when he was assassinated (in 244) by his soldiers at the instigation of Philip, prefect of the Prætorian guard.

GORDIUS. See NEMATELMIA.

GORDIUS, a peasant, who, according to the myth, was raised to the throne of Phrygia in consequence of the Phrygians being told by an oracle to appoint as their king the person whom they should meet, mounted on a chariot, going to the temple of Zeus. This was Gordius, who, to evince his gratitude, consecrated his chariot to Zeus, and fastened the pole with so ingenious a knot that the oracle promised the dominion of the world to him who should untie it. He built the capital Gordium. When Alexander the Great came to Gordium and saw the impossibility of untying the knot, he cut it with his sword.

GORDON, FAMILY OF, a Scottish historical house, now chiefly settled in Aberdeenshire, the origin of which is obscure. Probably the family came over to England with William the Conqueror, and settled in Berwickshire, where the place-names Gordon and Huntly still exist. The direct male line died out in the person of Sir Adam of Gordon, who fell in the battle of Homildon (1402). His only daughter was married to Alexander Seton (a descendant of Christal Seton, a companion of Wallace and Bruce), whose posterity took the mother's name, and from whom the ducal line takes its origin. The line of the Earls of Aberdeen springs from a collateral branch, whose founder was Patrick Gordon, who was killed at the battle of Arbroath, 1455. For some considerable period the family was the most influential in Scotland, and took an active part in the religious and dynastic struggles which harassed that kingdom. George Gordon, second earl of Huntly, was raised to the dignity of Chancellor of Scotland, a position he held from 1498 to 1502. His son Alexander, the third earl, commanded the left wing of the Scottish army at Flodden, but he escaped the carnage of that fatal field, and died in 1524. His grandson George, the fourth earl, raised the house to its highest pitch of power. He was lieutenant of the north, as well as Scottish chancellor, and added the earldom of Moray to his already extensive domains. The government, dreading his great influence, stripped him of the earldom of Moray, and he raised the standard of revolt, but was slain at Corrichie in 1562. His grandson George, the sixth earl, was the head of the Catholic party in Scotland, and in 1594 he defeated (at Glenlivet) an army sent against him under the Earl of Argyle. He, however, at a later period, submitted to the king, and was created Marquis of Huntly (1599). Three of the Gordons fell in the roval cause during the struggle of Charles I. with his people; Sir George Gordon was beheaded at Edinburgh in 1644; George, the second marquis, shared the same fate five years later, and his son fell at Alford in 1645, while leading a charge of the royal horse. During the revolution of 1688 George, the fourth marquis, who had been raised to the dukedom of Gordon in 1684, held out Edinburgh castle for King James. In the rebellion of 1715 and 1745 the Gordons took part on the Stuart side, but submitted after Culloden to the Hanoverian dynasty. With George, the fifth duke, who died in 1836, the ducal title became extinct, the estates falling to his nephew, the Duke of Richmond, the title of Earl of Huntly fell into abeyance, and that of Marquis of Huntly was adjudged to the Earl of Aboyne. The ducal title was, however, revived in 1876, and conferred on the Duke of Richmond and Lennox. One of the collateral branches of this family has become extinct, the Lords of Lochinvar and Viscounts of Kenmure, which was raised to the peerage in 1633, but forfeited the dignity in 1716, for participation in the rising of 1715. The title was again restored in 1824, but fell into abeyance in 1847. The earldom of Aberdeen was bestowed, in 1682, upon Gordon of Haddo, then the lord chancellor of Scotland. The fourth earl, who died in 1860, held the office of British prime minister from 1852 to 1855. Among some of the distinguished men connected with this branch of the family we may mention General Patrick Gordon (1635–99), who after serving in the armies of Sweden and Poland, finally entered the service of Alexei, czar of Russia, whose successor, Peter the Great, recognizing the many valuable services rendered by the skilful soldier to his father and himself, raised him to the rank of general. A journal kept by the general for the last forty years of his life has been abridged and published in German by Dr. Posselt (1849–53), and by the Spalding Club in 1859. The Gordons are still extensive land-holders in Aberdeenshire and one or two neighbouring counties.

GORDON, MAJOR-GENERAL CHARLES GEORGE ('Chinese Gordon' or 'Gordon Pasha'), was born at Woolwich, 28th January, 1833. He entered the Royal Engineers as second lieutenant in 1852, and served in the Crimea from December, 1854, to May, 1856. At the close of the war he was employed in surveying the Russian frontiers in Bessarabia and Armenia, whence he joined the military expedition to China, to compel the Chinese to ratify the treaty concluded by Lord Elgin, and also to exact reparation for the attack on the English squadron by the garrison of the Taku Forts. During the Taeping rebellion, Gordon, with the permission of the English military authorities, assumed the command of a special corps of Chinese, trained and led by European and American officers, which he found, however, in a thoroughly demoralized condition. With these materials he performed marvellous feats of skilful soldiership, and succeeded in completely crushing the rebellion. The Chinese government was eager to express its gratitude to the young officer who had rendered such valuable services, but he refused all offers of substantial reward, contenting himself with accepting a few unmeaning honours. On his return to England with the rank of colonel, he was appointed chief engineer officer at Gravesend for the construction of the Thames defences. Here, while his engineering work afforded ample scope for his military talents, the philanthropy of his nature had full scope. During the six years he lived at Gravesend his house was school, and hospital, and alms house in turn. Many a waif he rescued from the gutter, establishing evening classes for their benefit, and keeping sight of the more deserving till they

were provided with a career in life: all this being done on his pay as an English colonel, without any private resources whatever. In 1873, on the resignation by Sir Samuel Baker of his command under the Khedive of Egypt, Gordon was appointed in his place, and from 1874 until 1879 he governed the vast region of the Soudan with credit to himself and with satisfaction to the Cairo administration. Though regarded with jealousy by traders and by the native chiefs—the suppression of the slave-trade being a principal part of his task—he managed to secure a high reputation among the people for his justice and courage. After the deposition of the Khedive Ismail, Gordon left the Soudan, and soon after the vast region which he had almost wrested from the hands of the slave-dealers was allowed to relapse into their possession. On his return from the Soudan he was appointed private secretary to Lord Ripon, the viceroy of India, but he almost immediately resigned. After a flying visit to China he accepted the command of the Royal Engineers at the Mauritius, where the term of his office expired with his attainment of the rank of major-general. The Cape government appointed him to an important post in 1882, but a disagreement regarding Basutoland with the Cape ministry caused his resignation in a few months. Soon after Gordon left the Soudan the misgovernment of the Egyptians undid all the good which he had effected during his rule. In 1881 Mohammed Ahmed, of Dongola, a Mussulman enthusiast, gave himself out to be the Mahdi—the long-expected Redeemer of Islam—and gathered a number of followers around him who threatened the safety of the Egyptian garrisons in the Soudan. Several attempts to put down the rising by the Egyptians failed disastrously; and it having been decided that the Soudan be evacuated, the presence of an English officer of high authority at Khartoum was asked, who would have full power to withdraw all the garrisons in the Soudan, and to make the best arrangements possible for the future government of the country. Gordon had accepted a mission to the Congo from the King of the Belgians, President of the International Association, but this he resigned at the request of the British government, and proceeded to the Soudan in the hope that his great personal influence and knowledge of the country would help to set matters right. These hopes were not fulfilled: Gordon was shut up in Khartoum by the troops of the Mahdi, and for a whole year, with a garrison he could only half trust, he gallantly held that town against the hordes of Arabs who surrounded him. An English expeditionary force under Lord Wolseley was despatched for his relief, an advance corps of which sighted Khartoum on 28th January, 1885, to find that the town had been treacherously betrayed into the hands of the Mahdi's savages two days before, and that its heroic defender had been killed. Gordon had all the qualities which are found in a successful military leader, modified, however, by the strong religious feeling which tinged his mind from an early period, and which latterly became so intensified as to give him somewhat the character of a religious enthusiast and fatalist. He left a most interesting journal, kept during the latter period of his siege in Khartoum.

GORDON, Lord George, was the son of a Scottish peer, Cosmo George, duke of Gordon, and was born in 1751. He entered when young into the navy, but left the service during the American War. He then became a member of the House of Commons. His parliamentary conduct was marked by a certain degree of eccentricity, but he displayed no deficiency of talent, often animadverting with great freedom on the ministers and their opponents. In 1778, a bill having been passed through parliament for the relief of Roman Catholics from certain penalties and disabilities, a society called the Protestant Association of London was formed for the purpose of procuring its repeal. In the following year Lord George was elected its president, and in June, 1780, he headed an excited mob of about 100,000 persons, who went in procession to the House of Commons to present a petition against the measure. The dreadful riot which ensued, and which was not suppressed till after the destruction of many Catholic chapels and dwellings, the prison of Newgate, and the house of the chief-justice, Lord Mansfield, led to the arrest of Lord George Gordon, and his trial on the charge of high treason; but no evidence being adduced of treasonable design, he was acquitted. In May, 1786, he was excommunicated by the Archbishop of Canterbury for contempt, having refused to come forward as a witness in a court of law. He then published a Letter from Lord George Gordon to the Attorney-General of England, in which the Motives of his Lordship's public Conduct, from the beginning of 1780 to the present Time, are Vindicated (1787, 8vo). In the beginning of 1788, having been twice convicted of libelling the French ambassador, the queen of France, and the criminal justice of his country, he retired to Holland, but he was arrested, sent home, and committed to Newgate, where he passed the remainder of his life. He died, Nov. 1, 1793, having previously become a zealous professor of the Jewish faith.

GORDON, Sir John Watson, a distinguished Scottish painter, was born in Edinburgh in 1788, studied the art four years under John Graham, having Wilkie and Allan for his class-fellows. After some hesitation he resolved to devote all his energies to portrait-painting. He soon acquired celebrity, and was employed to paint the portraits of many of the most eminent Scotsmen of the day, among whom we may mention Sir Walter Scott, Dr. Chalmers, Professors Wilson, Ferrier, Munro, and Simpson, Principal Lee, Lord-president Boyle, the Duke of Buccleuch, Sir George Clark, De Quincey, George Combe, &c. In 1841 he was elected associate of the Royal Academy, and in 1850, on the death of Sir William Allan, elected president of the Royal Scottish Academy. In the same year he was appointed 'limner' to the queen, and received the honour of knighthood. In 1855 he sent two portraits to the Paris Exhibition, for which the jury awarded him a first-class medal. In his works Sir John was strictly faithful to nature, and succeeded in transferring the shrewd, cautious, and calculating features of his countrymen to the canvas better than any of his predecessors. He died at Edinburgh in 1864.

GORE, Catharine Grace, a well-known novelist, daughter of Mr. Moody, a wine merchant of East Retford, Nottinghamshire, was born in that town in 1799. In 1823 she was married to Captain Charles Arthur Gore of the 1st Life Guards, and shortly afterwards appeared her first novel, Theresa Marchmont, or the Maid of Honour, said to have been written in a week. This was succeeded by a long series of stories, chiefly presenting lively pictures of fashionable society, and including the Courtier of the days of Charles II.; Cecil, or the Adventures of a Coxcomb; The Hamiltons; The Banker's Wife; Pin Money; Peers and Parvenues; &c. In society Mrs. Gore's brilliant conversation, sparkling with wit and repartee, rendered her one of its leading stars. She died on 29th January, 1861.

GOREE, a small island belonging to France, on the coast of Africa, close to Cape Verd. On it is the town of Goree, with about 2000 inhabitants. It is an entrepôt of French trade, but as such is giving way to Dakar, on the mainland adjacent.

GORGET (French, *gorge*, throat), a piece of body armour, either scale work or plate, for the protection of the throat. It appears to have been first employed about the beginning of the fourteenth century. The *camail*, or throat covering of chain mail, which is sometimes called the gorget of mail, belonged more to the helmet than to the body armour. In the seventeenth century the gorget was still worn when other armour was laid aside.

GORGIAS, born at Leontini in Sicily, was a learned orator and sophist, who flourished in the fifth century B.C., living much at Athens. He is said to have been a disciple of Empedocles, and was one of the earliest writers on rhetoric. He displayed his eloquence at the Olympian and Pythian games, and made such an impression that a golden statue was erected to his honour at Delphi. He was one of the first who introduced cadence into prose. He also treated of *common-places*, and showed the use of them for the invention of arguments. This induced Plato to give the name of *Gorgias* to his elegant dialogue on this subject. Gorgias is said to have reached the extraordinary age of 107 or 108 years. Two works attributed to him are extant, The Apology of Palamedes, and the Encomium on Helena, but their genuineness has been questioned by several critics.

GORGO, or GORGON, according to Homer, one of the frightful phantoms of Hades; but Hesiod mentions three Gorgons, daughters of Phorcys and Ceto. Their names are Stheno, Euryale, and Medusa. They were all immortal, except Medusa. According to the mythologists, their hair was entwined with serpents, their hands were of brass, their body was covered with impenetrable scales, their brazen teeth were as long as the tusks of a wild boar, and they turned to stones all those who looked upon them. Medusa alone had serpents in her hair, according to Hesiod and Apollodorus, and this proceeded from the resentment of Athena, in whose temple Medusa had gratified the passion of Poseidon, who was enamoured of her on account of the beautiful colour of her locks, which the goddess changed into serpents. According to some authors, Perseus, when he went to the conquest of the Gorgons, was armed with an instrument like a scythe, by Hermes, and provided with a looking-glass by Athena, besides winged shoes and a helmet of Pluto, which rendered all objects clearly visible and open to the view, while the person who wore it remained totally invisible. With weapons like these, Perseus obtained an easy victory, and, after his conquest, returned his arms to the different deities whose favours and assistance he had experienced. The head of Medusa remained in his hands, and after he had finished all his laborious expeditions, he gave it to Athena, who placed it on her Ægis, with which she turned into stones all such as fixed their eyes upon it. It is said that, after the conquest of the Gorgons, Perseus took his flight in the air towards Æthiopia, and that the drops of blood which fell to the ground from Medusa's head were changed into serpents, which have ever since infested the sandy deserts of Libya. The horse Pegasus also arose from the blood of Medusa, as well as Chrysaor, with his golden sword. The residence of the Gorgons was beyond the ocean towards the west, according to Hesiod. Æschylus makes them inhabit the eastern parts of Scythia; and Ovid maintains as the more received opinion, that they lived in the inland parts of Libya, near the lake Tritonis, or the gardens of the Hesperides. Diodorus and others explain the fable of the Gorgons, by supposing that they were a warlike race of women near the Amazons, whom Perseus with a large army destroyed.

GORGONZOLA, a town and commune, Italy, in the government of, and 12 miles E.N.E. of Milan. It is memorable for the surprise and defeat of the Milanese in 1158 by Frederick Barbarossa; and has a magnificent church, supported by forty-four Corinthian columns and numerous sculptures, frescoes, and paintings. Its principal trade is in a kind of ewe-milk cheese, called *stracchini*. Pop. 4320.

GORILLA, an anthropoid ape, the largest of its class, and one that in conformation of body comes nearer to man than any other of the quadrumana. The adult male is from 5 to 6 feet in height, and is one of the most terrible animals to be encountered, being even able to maintain a successful conflict with the lion and leopard. The hands and arms are endowed with enormous strength, enabling it, it is said, to break with ease trees of 3 or 4 inches in diameter, while the sunken eyes and projecting rows of enormous canine teeth give it an indescribably hideous and terrific appearance. One special resemblance to man is in the greater size of the heel and greater breadth of the foot, which enable the gorilla to walk erect with greater ease than other apes. Its general mode of progression is on all fours, leaning on the knuckles; but when attacked or alarmed it raises itself up and advances to meet its antagonist, beating its huge breast with its hand, and roaring in the most frightful manner. Though possessing a greater anatomical resemblance to man than other apes, it is much more deficient in intelligence and docility than the chimpanze and one or two other species, and has hitherto proved perfectly untamable even when taken young. It inhabits the western parts of Equatorial Africa, being found in the darkest and most impenetrable forests, about 1° or 2° on each side of the line. It is entirely frugivorous, living on roots and berries. The relations of this ape to man have been the subject of keen discussion. The principal points may be summed up as follows:—The foot is longer than the hand, as in man; in the gibbon it is the reverse; in the chimpanze they are equal; in the orang the foot is longer, but both extremities are very narrow. The curves of the vertebral column in the gorilla are similar to those in man; the resemblance being successively less in the chimpanze, orang, and gibbon. The ribs are thirteen in the gorilla and chimpanze, fourteen in the gibbon, the orang having twelve, as in man. The gorilla and chimpanze have eight bones in the carpus or wrist, the others having nine; the thumb of the gorilla is more, that of the others less, than one-third of the length of the hand. The pelvis of the gorilla is most human in the breadth of the iliac bones. The upper arm is longer than the forearm, equal to it in the chimpanze, and shorter than it in the gibbon. The massive skull of the gorilla has enormous sagittal and lambdoidal crests and supraorbital ridges, the actual disproportion of the face (including the lower jaw) to the skull being thereby made to appear greater. The length of the brain cavity is less, in man is more, than twice that of the cranial axis. The volume of the brain of the orang and chimpanze is 26 or 27 cubic inches, in the gorilla 35; in man it is only exceptionally less than 55. The cerebral hemispheres are lower and the convolutions simpler than in man. There is a diastema or canine gap in the dental series, the teeth of man forming a continuous series. The proportion of the skull to the size of the jaws and body diminishes as the young apes approach maturity, and the limbs enlarge without altering their proportions. Whereas in man, if the height of the adult be taken as three and a half times that of the new-born child, the head of the former is twice that of the latter, and the limbs are five times as long. The human legs grow more rapidly than do the arms, and the forearm and shinbone grow more rapidly than the upper arm and thigh. Anatomically, there-

fore, the gorilla is separated from man by more than generic differences, while the gap is still wider if we look to the psychical endowments of the two. (See MAN.) The gorilla was first fully described by Du Chaillu.

GORKUM (properly *Gorinchem*), a town of the Netherlands, in the province of South Holland, on both sides of the Linge, at its junction with the Merwede, 22 miles E.S.E. of Rotterdam. It has relics of old fortifications, and communicates across the river by three wooden bridges. It has several churches, a synagogue, a town-house, custom-house, several schools, an arsenal, hospitals, breweries, tanneries, rope-walks, boat-building yards, and a good harbour, with a trade in farm produce. Pop. (1899), 11,855.

GÖRLITZ, a town in the Prussian government of Liegnitz, province of Silesia, in Upper Lusatia, on the Görlitzer Neisse, about 10 miles from the Bohemian frontier. The river is here crossed by three bridges. Most of the old fortifications have been removed. Among the chief buildings are the Protestant church of St. Peter and St. Paul, dating from the thirteenth century, with a good crypt and two towers; several other fine Gothic churches; the town-house; an old tower, the Kaisertrutz, now used as a guard-house; the town theatre; the gymnasial building; the central and other hospitals; and a hydropathic. Outside the town is the holy sepulchre, which, in 1489, the burgomaster Emerich caused to be built after the model of that in Jerusalem. The Upper Lusatian Society has a library of 60,000 volumes. The chief industry is the manufacture of cloth, and of the other manufactures the most important are railway materials, machinery, gold, silver, and wire articles, toys, cigars, and chemicals. There is a considerable trade. The town has rapidly increased in prosperity since the laying down of the Saxon-Silesian railway; the population, which in 1831 was only 8000, was, in 1900, 80,931.

GÖRRES, JAKOB JOSEPH VON, a distinguished German publicist and author, was born at Coblenz, 25th January, 1776. Few of even the most enthusiastic young men of Germany greeted the outbreak of the French Revolution with such warmth as Görres. He established a newspaper, Das rothe Blatt, which was suppressed on account of its extreme opinions and its fearless attacks on those in power. In 1799 he was sent to Paris at the head of a deputation to negotiate the annexation of the Rhenish provinces to France; but the revolution of the 18th Brumaire intervened, and the First Consul had not time to receive the deputation. Görres returned to Germany, quietly settled down in a professorship of natural history in his native town, and for several years devoted himself exclusively to literature. In 1807 he published a collection of German legendary tales, Deutsche Volksbücher. When the disastrous French campaign in Russia aroused the hope of liberation from foreign yoke throughout Germany, Görres became, by the establishment of his spirit-stirring Rheinische Mercur, the literary centre of the national movement. This journal he continued after the Germans had achieved their independence; but, as he addressed himself against domestic absolutism with as much vigour as he had declaimed against foreign tyranny, his paper was suppressed in 1816. About this date appeared his collection of old German Volks- und Meisterlieder. In 1820 he was compelled to flee to Switzerland, having incurred the wrath of the Prussian government by his treatise Deutschland und die Revolution. In 1827 he was appointed professor of the history of literature in the University of Munich, just founded by the munificent King Ludwig of Bavaria. From this time his life was devoted to literature and the religious controversies engendered by the arrest of the Archbishop of Cologne by the Prussian government, and subsequently by the appearance of Strauss's book on the life of Jesus. In all these struggles Görres showed himself an ardent Catholic. He had also the principal hand in the establishment of the Historisch-politische Blätter, one of the leading Catholic periodicals of the world. He died 29th January, 1848. His daughter Marie Görres published an edition of his works in eight vols. (Munich, 1854–60).

GORTSCHAKOFF, PRINCE MICHAEL, a noted Russian general, was born in 1795, of an old and distinguished family, took part as an artillery officer in the battle of Borodino in 1812, and served in the subsequent campaigns of the allies against the French. In 1828 he was appointed general of brigade and chief of the third corps for maintaining the war with the Turks on the Danube, and greatly distinguished himself in this campaign and by the taking of Silistria in the following year. He acquired also a brilliant reputation in the Polish war of 1831; was made a general of artillery; and was severely wounded at the battle of Grochow. In 1846 he was made governor of Warsaw, and in 1849 accompanied Prince Paskevitch in the Russian invasion of Hungary. In the war with Turkey and the western powers he received, in 1853, the command of the army on the Pruth for the invasion of the Danubian principalities, and in 1855 was appointed commander-in-chief in the Crimea, where he conducted the defence of Sebastopol. In 1856 he returned to Poland as governor of the country, and died at Warsaw in May, 1861. By his express desire his body was carried to Sebastopol, and buried in the place he had so long and so bravely defended.

GÖRZ, a town of Austria, in the province of Görz and Gradisca, on the left bank of the Isonzo, 23 miles N.N.W. of Trieste. It occupies a very picturesque site, being built in the form of an amphitheatre, on a mountain slope, and consists of the high town, surrounded by walls and defended by an old castle; the new town, situated in the plain on the left bank of the river; and several suburbs. The houses are generally substantial, and in the Italian style; but the streets are irregular. Görz is the seat of an archbishop, and contains a cathedral, a fine building with a beautiful chancel; an elegant bishop's palace, a court-house, town-house, hospital, theatre, ecclesiastical seminary, an old Jesuit's college, now converted into barracks; an old castle, used chiefly as a prison, &c. The manufactures are of considerable importance, and consist chiefly of leather, confectionery, earthenware, rosoglio, refined wax, and refined sugar. There are also several silk-mills. It is now a favourite winter resort for invalids from various countries. Charles X. of France died here in 1836. Pop., (1890), 21,825; (1900), 25,432.

GOSHAWK (*Astur*). Several species of the genus *Astur* of the family Falconidæ are known. The only British species, now a comparatively rare visitor, is *A. palumbarius*. Very like it in many ways, but larger and handsomer, is the American species (*A. atricapillus*). A white species (*A. Novæ Hollandiæ*) inhabits Australia. Systematists usually place the goshawks near the sparrow-hawks and harriers, especially the former, which they resemble in the shortness of their wings and other distinctive characters. The common goshawk is twenty-one inches in length; the bill and cere are blue; crown, black, bordered on each side by a line of white, finely speckled with black; upper parts, slate, tinged with brown; legs, feathered half-way down, and, with the

feet, yellow; tail-feathers with pale bands. The goshawk commonly feeds on mice and small birds, and eagerly devours raw flesh. It plucks the birds very neatly, and tears them into pieces before it eats them, but swallows the pieces entire. The goshawk was formerly much used in falconry, and indeed is so employed still, being flown at pheasants and rabbits. See illustration at ORNITHOLOGY.

GOSHEN, a district of ancient Egypt, which Joseph procured for his father and brethren. It is supposed that the land of Goshen lay between the eastern part of the Delta and the western border of Palestine, that it was scarcely a part of Egypt proper, and was inhabited by other foreigners besides the Israelites; that it was a pastoral country especially suited to the Israelites, who there prospered, and were separated from the main body of the Egyptians; and that it corresponds to the valley now called the *Wâdi-et-Tumeylât*, a tract comprehending an area of about 60 square miles.

GOSLAR, a town of Prussia, in the Harz Mountains, on the Gosse, at the foot of the Rammelsberg. It is an ancient town (founded by Heinrich I. about 920), and once ranked as a free imperial city. It is an interesting place, with numerous towers and quaint old houses. Its more remarkable buildings are a town-house of the fifteenth century, with paintings by Wohlgemuth, old instruments of torture, and other curiosities; a fine Romanesque church of the twelfth century, and another of later date; an old cathedral chapel with interesting relics; an old imperial palace, now restored and adorned with fine frescoes; an old guild-house (now an inn), adorned with statues of eight German emperors; the new post-office, built in 1893; and the classical school. The principal occupation is mining, and there are manufactures of chemicals, matches, cigars, &c. Pop. (1900), 16,403.

GOSPEL (A. Sax. *god-spell*, from *gôd*, good, and *spell*, tale, account, message), the name for any one of the four books of the New Testament which give an account of the life and teaching of Christ, the word being a translation of the Greek term *euangelion* (whence Latin, *evangelium*; English, *evangel*, *evangelist*), the etymological meaning of which is 'good tidings'. As used in connection with the New Testament, the Greek word meant first the substance of the gospel history, and later, from about the middle of the second century, any of the books containing it. The four gospels, bearing the names respectively of Matthew, Mark, Luke, and John, profess to be written in apostolic times, and were declared canonical at an early date. Though they hold a position at the beginning of the New Testament, they are not the earliest in date of its component parts, and it is generally agreed that the first three—which, on account of their possessing various features in common, are known as the *Synoptic Gospels*—are earlier than the fourth, or Johannine. (See BIBLE.) So different indeed is the fourth gospel from the others that in discussing the many interesting and difficult questions connected with all of them, it is common to treat the last apart from the others.

The shortest and probably the earliest gospel is that of St. Mark, who is generally identified with 'John, whose surname was Mark', mentioned in the Acts and elsewhere. There is a wide-spread and early tradition that he was the disciple and interpreter of Peter, to whom he was indebted for much of the matter contained in his gospel. This is supported by internal evidence also, since scarcely a work of Christ is narrated at which Peter was not present, and most of the incidents are recorded after the manner of one who was an eye-witness. This gospel displays only an imperfect knowledge of the Greek language, terms being used which are regarded as harsh and uncouth by educated Greeks, and some being expressly forbidden by the Greek grammarians. The gospel appears to have been specially designed for Gentile members of the church, and accordingly gives numerous explanations of Jewish topography and Jewish manners and customs. The writer seems to desire chiefly to set before us the humanity of Jesus, and to present the acts rather than the words of the Saviour in his narrative. His style is graphic and forcible though rude; places and surroundings are described with some minuteness, and a similar care is displayed as to persons and numbers. His narrative begins with the ministry of John, and the first events in the life of Jesus are his coming from Nazareth, his baptism and temptation in the wilderness, there being no mention of his genealogy, miraculous birth, or early life. This gospel deals very briefly with the resurrection, and the part of the last chapter (verse 9 to the end) in which the ascension is mentioned is not found in the earliest MSS., and is now generally regarded as having no claim to belong to the original book.

The gospel of St. Matthew is probably the next oldest. The opening chapters give a brief notice of the infancy and childhood of Jesus, and an account of the circumstances attendant upon his entrance on his public ministry. His public life, his teachings and parables, are then recorded, and the story closes with a record of his sufferings, death, and resurrection. The design of Matthew is evidently to exhibit to his countrymen Jesus as the promised Messiah, in whom was fulfilled 'that which was spoken by the prophets'. He gives no explanations of topography or customs, but supposes his readers to possess the necessary acquaintance with them. He traces the genealogy of Jesus through Joseph and Abraham, and refers eight times to Jesus as the son of David, thus directly appealing to distinctively Jewish feelings. There is a tradition, which is almost unanimously supported by the fathers, that Matthew not only wrote for the Jews, but that he also wrote in Hebrew (that is, in the vernacular Aramaic). No certain trace exists of any such original Hebrew version, though a gospel written in Hebrew characters ('the Gospel of the Hebrews'), and ascribed to Matthew, seems to have been known at an early period. Some think that this latter was a Hebrew edition of our Gospel issued after the Greek had already been published. As to the date of the gospel according to St. Matthew, authorities are divided. Some maintain that internal evidence proves it to have been written before the destruction of Jerusalem (A.D. 70), while others would assign it to a period several decades later.

The third of our gospels is that according to St. Luke, who was also the author of the Acts of the Apostles, and the friend and companion of Paul, who refers to him as 'the beloved physician'. The design of this gospel is stated in the first four verses, in which the author, who writes in the first person, dedicates it to a certain Theophilus, probably a man of rank and a patron, unless the name be designed to include all 'beloved of God'. Luke is generally regarded as being a person of scholarly attainments, and the style and language of his gospel is more classical than that of his predecessors. His history is believed to preserve the chronological order of the main facts with greater care than those of the other evangelists, and he gives numerous and important incidents omitted by them. Designed more especially for Gentile converts, it contains explanations that would be unnecessary for Jews,

and its aim appears to be to exhibit Christ as the Saviour of all men, thus reflecting the teaching of Paul in its catholicity and fulness. Its date cannot be fixed with any degree of certainty, but it seems to have been written after the fall of Jerusalem, possibly about the year A.D. 80. Some modern critics maintain that though this gospel and the Acts were by the same author, this was not Luke, the companion of Paul, and they assign the composition of the former to a later date than that just indicated.

In regard to the amount of unity existing between the synoptic gospels, the following statements may be made as approximate. If the three be divided into sections, there are forty-three which are common to all. This does not imply literal agreement, but that there is a substantial coincidence as to fact and utterance. Besides these there are fourteen sections common to Matthew and Luke, twelve to Matthew and Mark, five to Mark and Luke, while Luke has nine sections peculiar to himself, and Matthew five. There are only twenty-four verses in Mark which contain any important fact omitted by the other evangelists, but these contain two miracles, namely, the healing of a deaf and dumb man, and the restoration of sight to one that was blind. With regard to apparent discrepancies, we may instance the genealogies of Christ given in Matthew and Luke; the healing of the two demoniacs mentioned by Matthew while Mark and Luke speak only of one, the restoration of sight to two blind men near Jericho, also mentioned by Matthew, where again the other two gospels speak of but one; the healing of the centurion's servant recorded by Matthew and Luke, but with considerable variation in the circumstances; and, above all, the different accounts of the appearances of Jesus to his disciples after his resurrection.

These and other apparent discrepancies have always been a source of difficulty to commentators and serious students, but extraordinary coincidences in the use of language — coincidences far greater than could be believed possible on the part of writers independently narrating the same events — have also been noted as requiring explanation. The discrepancies have been, and are, reconciled in various ways, and so with the coincidences in language, though formerly the latter were regarded as comparatively easy to deal with. The language of each gospel was simply that of inspiration, its words were really those of the Holy Spirit, and no more was to be said, except that borrowing by one gospel writer from another may have taken place. Few, if any, modern critics take such a view as this, and the whole problem of the origin and history of the gospels has in later times assumed an entirely different character from what it once possessed. Many recent critics refuse to regard any of our three synoptics as narratives written at first hand by authorities personally acquainted with all the facts and without reference to already existing sources; and indeed the preface to Luke expressly says that 'many' had written on such matters as the writer himself was about to treat of. The different theories as to the origin, interdependence, and development of the three gospel narratives must be studied in commentaries and special works; but, speaking generally, the modern view is that, besides tradition or living testimony, there were also one or more written sources on which our gospels are based, and more particularly a collection — or collections—in Greek, of the sayings and discourses of Christ (known by the name of *logia*). In such discussions it has become common for writers to speak of the 'triple tradition' and the 'double tradition' (or traditions), the former referring to matter common to all the three gospels, the latter to such as is common to any two, as Matthew and Mark, Mark and Luke, Matthew and Luke, the last being much the fuller.

With regard to the fourth or Johannine gospel, there is a general consensus of opinion that it is considerably later than the other three, which were well known in the church before its publication; and it has been characterized as 'in effect *the earliest commentary on the Synoptists*'. The readers of this gospel are apparently supposed to be already acquainted with the principal events in the life of Jesus, as most of the incidents recorded in the synoptical gospels are passed over, while the parables, the sermon on the mount, and all the miracles save eight are also omitted (notably those of the casting out of devils). Certain words and expressions characteristic of the other gospels are not found in this: for example 'repent', 'repentance', 'baptism', 'preach', 'sinners', 'publicans', 'cast out devils', &c. A comparatively large space is taken up with additional matter, and about one-third is devoted to an account of the sayings and doings of Jesus during the twenty-four hours preceding his crucifixion (but nothing is said of the institution of the eucharist). Four at least of the miracles are peculiar to John, including the greatest of all, the raising of Lazarus after he had been four days dead. In this gospel Jesus is spoken of as attending three passovers at least, and most of it is occupied with the words and works of Jesus in Judea, while the Galilean history is chiefly given by the other evangelists, who also refer to one passover only. The reference to Christ as the Word (Greek, *Logos*) in the prologue to this Gospel, and the subsequent development of this idea, the different character of the reported discourses of Christ (long expositions as compared with short sayings), the additional details it contains regarding his appearance after the resurrection, with various other considerations, have led many critics to assign its composition to a period later than that of the apostle John (perhaps as late as A.D. 140), and to an author whose name is unknown. On the other hand, its genuineness and authority, as the work of one of the apostles, are defended by some of the foremost scholars. Certain small portions, however, are regarded as doubtfully genuine; one verse (chap. v. 4) is omitted from the revised version of 1881, while another portion (chap. vii. 53 to viii. 11) is marked as doubtful. There are a few apocryphal gospels of early date still extant in a very fragmentary state, and one or two more complete, such as the Book of James and the Acts of Pilate or Gospel of Nicodemus. See on the whole subject of the Gospels the Bible dictionaries, such as Smith's, Hastings', and the Encyclopædia Biblica; and such special works as Westcott's Introduction to the Gospels; Abbott and Rushbrooke's Common Tradition of the Synoptic Gospels; Salmon's Introduction to the New Testament; Wright's Composition of the Gospels; &c.

GOSPORT, a market town and seaport in England, in the county of Hants, on the west side of the entrance to Portsmouth harbour, and directly opposite the town of Portsmouth, connected by a floating bridge, and surrounded by a fortified wall and ditch, forming part of the defences of Portsmouth, Portsea, and Gosport. The houses are generally of brick. Trinity Church is in Ionic style, and dates from 1696; it contains the organ used by Handel in composing Esther. Other chief buildings are the Thorngate Memorial Hall, the Market House, Soldiers' Home, schools, barracks, &c. A considerable coasting trade is carried on here, also yacht-building and sail-making, while there is an establishment where

anchors and chain cables are made. But the principal object of interest in Gosport is the Royal Clarence Victualling Yard, which can supply any number of ships with provisions at a moment's notice. On the south-west side of the town is the famous Haslar Hospital for invalided sailors, of whom 2000 can be accommodated. Populous suburbs have grown up outside of the old fortifications. Pop. in 1891, 25,432; in 1901, 28,879.

GOSSAMER is the name of a fine filmy substance, like cobweb, which is seen to float in the air in clear days in autumn, and is most observable in stubble-fields, and upon furze and other low bushes. This is formed by several kinds of small spiders, which are wafted through the air along with their webs, the webs being often borne down by the dew, &c. Why these fine threads are formed at all, and at the particular time of year at which they are commonly produced, is not very clearly ascertained; they certainly serve to transport the small creatures that produce them from place to place whether this be their primary object or not.

GÖTEBORG, or GÖTHEBORG. See GOTTENBURG.

GOTHA, a town of Germany, capital of the Duchy of Saxe-Coburg-Gotha, pleasantly situated on the Leina canal, here crossed by several bridges, 14 miles W.S.W. of Erfurt. It consists of the town proper and suburbs, the former occupying the side of a hill, surrounded by promenades which have taken the place of the old ramparts. The houses are generally well built, and the streets wide and tolerably straight. The principal buildings are the ducal castle or palace, called Friedenstein, occupying the crown of the height on which the town is situated. It is a large, and, from its elevated site, a conspicuous edifice, not possessed of much architectural merit, but surrounded by fine terraces, and containing a library of 200,000 vols. and 7000 MSS.; a collection of over 80,000 coins and medals, &c. The museum, beside the castle, built in 1864–77, contains a valuable collection of pictures, and collections of antiquities, minerals, natural history specimens, &c. There are also other two palaces; several churches; a town-hall, built in 1567–77 and recently restored; a court-house (1896); a gymnasium, &c. The industries include porcelain, musical instruments, machinery, tobacco, and toys. The Perthes geographical institute here is famous. Pop. (1900), 34,651.

GOTHARD, ST., a mountain group in Switzerland, on the confines of the cantons Tessin and Uri, belonging to the Lepontine or Helvetian Alps, which it connects with the Bernese Alps. It forms a kind of central nucleus in the great watershed of Europe; each of its slopes giving rise to an important river—the north to the Reuss, the south to the Tessin or Ticino, the west to the Rhone, and the east to the Rhine; all which rivers rise within a circuit of 10 miles from its centre. Its culminating point has a height of 10,600 feet, and at least three of its other summits are beyond the limit of perpetual snow. The Col of St. Gothard, at its summit level, where the Hospice stands, is 6808 feet high. Over it an excellent carriage road was completed in 1832, in which, particularly on the Italian side, formidable difficulties have been surmounted, and much engineering skill displayed. A railway tunnel has been pierced through this mountain group between Göschenen on the north and Airolo on the south, thus directly connecting the railway system of North Italy with those of Switzerland and Western and Central Germany. This tunnel is the longest in the world after the new Simplon tunnel, being 16,295 yards, or rather more than 9¼ miles long. It was constructed in 1872-81 and opened for traffic early in 1882. Its total cost was about £2,400,000. The most improved machinery and methods of excavation were employed, but the work was often impeded by the falling in of the rock and by the irruption of water from the fissures in the strata. The excavation was carried on simultaneously on the Italian and the Swiss side, the workmen finally meeting in the middle, where the height above sea-level is 3785 feet.

GOTHIC, the language of the Goths, a dead language, known to us almost solely through fragments of a translation of the Bible made by Ulphilas (Ulfilas), bishop of the Goths of Mœsia, in the fourth century, the extant portions belonging chiefly to the New Testament. It was one of the Teutonic tongues, and as such a sister of Anglo-Saxon and English, German, Dutch, Danish, &c. It was committed to writing much earlier than any other Teutonic language, and exhibits archaic and other peculiarities entirely its own. It is richer in inflexions than any other of the Teutonic tongues, and altogether is of the highest value in the study of Teutonic philology in general. As Ulphilas employed the language of the Goths of Mœsia, the name Mœso-Gothic is often applied to this tongue. The alphabet which he used is supposed to have been invented by himself, being based most largely on Greek characters, with the adoption of others from the Latin, and from the Runic alphabet. Various useful works for the study of Gothic have been published in English, among the writers being Skeat, Douse, Wright, Broune, Balg &c.; besides numerous works published in Germany. See GOTHS, ULFILAS, PHILOLOGY.

GOTHIC STYLE. See ARCHITECTURE.

GOTHLAND, or GOTTLAND (Swedish, *Götaland*), one of the large sections into which Sweden was originally divided, and including the whole of that country south of lat. 59° 20′ N. It contains about one-fourth of the whole. (See also GOTTLAND.)

GOTHS, an ancient Teutonic tribe, whose earliest known home was the shores of the Baltic, between the Vistula and the Oder, where they were living in the first century after Christ. Leaving their habitations here, they removed to the regions adjoining the Black Sea. Many other tribes were incorporated with them, and by continual advances and conquests they established, under Ermenric (about 350), the great Gothic kingdom, extending from the Don to the Theiss, and from the Black Sea to the Vistula and the Baltic. This naturally brought the Goths into continual contact, on the west with the Roman Empire, and on the east with that of Constantinople; and their history is full of the struggles which they maintained, sometimes on the one side, sometimes on the other. Two emperors fell in battle with them, and Rome and Constantinople were both forced to pay them tribute. About the year 369 internal commotions produced the division of the great Gothic kingdom into the kingdom of the Ostrogoths (eastern Goths), on the shores of the Black Sea, from the Don to the Dnieper, and the kingdom of the Visigoths (western Goths), from the Dnieper to the Danube. These internal storms were soon followed by one from without, which effected the subversion of the Gothic power in those parts. About the year 375 vast multitudes of the Huns and of the Alans, who had been subdued by them, poured out of Asia, and drove back the Ostrogoths upon the Visigoths. The Goths obtained permission from the Emperor Valens to settle in Thrace, but were driven to rebellion by the oppression of the imperial governor. In the war which ensued Valens himself was completely defeated by them at Adrianople in 378. From that time they had an important influence in the affairs of Constantinople. After many vicissitudes the Ostrogoths obtained a settlement in Pannonia and Slavonia, but not till the destruction

of the kingdom of the Huns in 453. The Visigoths in process of time obtained a degree of power which excited alarm in Greece and Italy. In 369 Alaric made an irruption into Greece, laid waste the Peloponnesus, and became prefect of Illyria and King of the Visigoths. He invaded Italy about the beginning of the fifth century, and by that measure brought on the destruction of the Roman Empire, since Stilicho, the Roman general, could only obtain a victory over Alaric at Verona (in 403) by withdrawing all the Roman troops from the borders of the Rhine. Alaric himself soon returned to Italy, and sacked Rome in 409, and a second time in 410. After his death (in 410) the Visigoths succeeded in establishing a new kingdom in the southern parts of Gaul and Spain (*Septimania, Gothia*), of which, towards the end of the fifth century, Provence, Languedoc, and Catalonia were the principal provinces, and Toulouse the seat of government. The last king, Roderick, died in 711 in battle against the Moors, who had crossed from Africa, and subsequently conquered the kingdom. After the fall of the Western Roman Empire, by the invasion of Odoacer in 476, the Eastern emperor, Zeno, persuaded Theodoric, king of the Ostrogoths, to invade Italy in 489. The Goth became king of Italy in 493, and laid the foundation of a new Ostrogothic kingdom, which, together with Italy, comprised Rhætia (a part of Switzerland and the Tyrol), Vindelicia (part of Bavaria and Suabia), Noricum (Saltzburg, Stiria, Carinthia, Austria), Dalmatia, Pannonia (Farther Hungary, Slavonia), and Dacia beyond the Danube (Transylvania, Walachia). This kingdom came to an end in 554. As the Goths were a thoroughly German race their religion must, on the whole, have been that common to all the Germans; but ever since the time of Constantine the Great Christianity appears to have gradually taken root among the Goths settled in Moesia, whence a Gothic bishop is mentioned as present at the Council of Nicaea, 325 A.D. Their form of Christianity was Arianism, which was patronized by their protector Valens, and certainly adopted by their bishop Ulphilas. The introduction of Christianity among these Goths, and the circumstance of their dwelling near and even among civilized subjects of the Roman Empire, greatly contributed to raising them in civilization above the other German tribes. Bishop Ulphilas, in the fourth century, translated, if not the whole, at least the greater part of the Bible into Moeso-Gothic, using an alphabet which he formed out of those of the Greeks and Romans, which was in time adopted by all the German tribes. Unfortunately only a small portion of this translation has come down to us; but this is quite sufficient to enable us to form an opinion of the language at that time. It contains many words which the Goths borrowed from the Latins and Greeks in their intercourse with them. Besides this translation there exist a few other monuments of the language, which are, however, of minor importance. We may observe here that of all the Germanic dialects the Swedish is least like the Gothic, though there is a tradition that Scandinavia was the original home of the Goths. The fact that the Goths once did dwell in Scandinavia is, indeed, attested by a vast amount of evidence, among which the names of places are not the least important; but the probability is that the Goths migrated thither from the country on the east of the Vistula even before they proceeded southward. All the Gothic princes and tribes were tolerant of the religion of others. The Catholics themselves generally acknowledged that they were not only unmolested under Theodoric, who was an Arian, but even that at no other period did their church enjoy greater prosperity. The Goths were also distinguished in some degree as friends of the fine arts. Theodoric established the office of a *comes nitentium rerum* (overseer of works of art), whose business it was to guard the statues and watch over the preservation of public buildings. These were not only kept in repair, but Rome and various other cities were adorned with new edifices. The laws of the Visigoths were digested into a regular code fifty years before the pandects of Justinian. Theodoric and the Goths in Italy preserved the Roman laws. Their form of government was absolute monarchy, of a mixed elective and hereditary character.

GOTTENBURG, or GOTHENBURG (Swedish, *Göteborg*, or *Götheborg;* Latin, *Gothoburgum*), a seaport town in Sweden, the second in the kingdom in respect of population and trade, capital of the län of the same name, picturesquely situated on the Gotha or Göta, here nearly 1 mile wide, 5 miles east of its mouth, in the Kattegat, and 255 miles W.S.W. Stockholm, with which it is connected by rail. It consists of the town proper, and of several suburbs; and is defended by two forts. There is a dry dock cut out of the solid rock, and the completion of the Göta canal, as also the railway facilities have increased its importance. The houses, either of brick, faced with stucco, or of stone, have always a substantial and often an elegant appearance; the streets, generally spacious and well paved, intersect each other at right angles; while several canals, branching off from the river, traverse the town in different directions, and by the numerous and often handsome bridges which cross them, and the rows of trees which line their banks, produce a very pleasing effect; so that Gottenburg, on the whole, is generally regarded as the best built place in Sweden. The principal public buildings are the cathedral, a simple but elegant structure; the town-house, new exchange, governor's residence, bishop's palace, gymnasium, with library attached; infirmary, several hospitals, and other benevolent institutions; theatre, baths, and artillery barracks. The manufactures include iron, steel, machinery, sail-cloth, linen, and leather, and there are also oil-presses, cotton-mills, dye-works, and building-yards at which a considerable number of vessels are launched; but by far the most important industrial establishments are tobacco factories, porter breweries, and sugar-refineries. The trade is very extensive, the harbour being excellent and always free from ice. The chief exports are iron and steel, copper, wood, tar, linseed, bark, bones, juniper berries, cranberries, and the above articles of manufacture; the chief imports—colonial produce, wine, salt, seal-oil, cotton yarn, and twist. Among social reformers the town is noted for its licensing system, under which (since 1865) the public-house licenses are granted to a company, which places managers at fixed salaries in the houses, and, after paying the expenses of management, with 5 per cent annual interest on the shareholders' capital, makes over the profits to the town treasury. Pop. (1901), 132,111.

GOTTFRIED VON STRASBURG. See GODFREY OF STRASBURG.

GÖTTINGEN, a town of Prussia, in the province of Hanover, in the beautiful and fertile valley of the Leine, on both sides of an arm of which it stands, surrounded by gardens and country seats, 59 miles S.S.E. Hanover. It is a place of great antiquity, and was early fortified; but the ramparts have been planted, and converted into agreeable promenades. The town is generally well built, having wide and spacious streets, four public squares, and houses which are almost always substantial, and often elegant. The public edifices include several churches and a synagogue; a town-house, court-house, merchant-house, infirmary, orphan and other hospitals; but they are all eclipsed

by the university, which has long enjoyed a European reputation, and which was founded by George II. of England and elector of Hanover in 1734, and opened in 1737. It greatly fell off after the expulsion of the seven professors, Albrecht, Dahlmann, Ewald, Gervinus, the two Grimms, and Weber, for political reasons, but has again recovered itself since 1866, and now has an average attendance of over 1000 students, and some eminent names among its professors. The principal building, to which William IV. of England contributed £3000, was completed in 1837. Connected with the university are a museum with extensive and valuable collections, an observatory, an anatomical theatre, botanical gardens, and a library possessed of about 500,000 printed volumes and nearly 6000 MSS. The manufactures are of very little importance, and consist chiefly of a few woollen tissues, tobacco, leather, paper, books, and philosophical instruments. The trade has been greatly benefited by the construction of railways. Pop. (1900), 30,234.

GOTTLAND, or GOTHLAND, the largest island of the Baltic, belonging to and 55 miles east of the coast of Sweden. It is of irregular shape, bulging out towards its centre, and thence tapering north and south to its extremities; length N.N.E. to S.S.W., 78 miles; central breadth, 34 miles. The coast is for the most part rocky and deeply indented by bays, forming many harbours, of which that of Slite, on the north-east coast, is equal to any in the Baltic. The interior consists of a limestone plateau, intersected near its centre by a range of heights, which, though nowhere above 200 feet high, seem from their abruptness to have a much greater elevation. The climate is so much milder than the opposite mainland that the walnut, mulberry, and grape ripen in the open air. The soil is fertile, and produces as much grain as leaves a large surplus for export. The land is divided among many small proprietors, who live in separate and detached homesteads. Wood is abundant, often fringes the water's edge, and adds much richness and beauty to the scenery. Gottland attained its greatest prosperity during the Hanse League, of which its capital, Wisby, was an important member. It had then 100 churches, many of which, now in ruins, form objects of interest to the antiquary. The län of Gottland is formed by Gottland and the adjoining islands. The chief exports of Gottland are wood, grain, sandstone, marble, lime, and leather. Pop. of län (1900), 52,781.

GOTTORP. See HOLSTEIN.

GOTTSCHED, JOHANN CHRISTOPH, born on Feb. 2, 1700, at Judithenkirch, near Königsberg, in Prussia, received from his father, who was a preacher there, his first instruction in the languages and the sciences, and entered the university of Königsberg as early as 1714. His inclination soon turned from theology, to which he had been destined, to philosophy, the belles-lettres, and the languages. In 1724 he went to Leipzig, and delivered lectures on the belles-lettres, in which he attacked the then prevalent corruption of taste, and recommended the imitation of the ancients, and their professed followers, the French. In 1728 he published the first sketch of his Rhetoric, which he afterwards much enlarged, and in 1729, for the first time, his Kritische Dichtkunst (Critical Art of Poetry). Both these works, unlike the books of instruction then in general use in Germany, condemn the disfigurement of the language by the use of foreign words, and oppose the taste for bombast in poetry which then prevailed. In 1730 he was made professor of philosophy and poetry, published his Contributions towards a Critical History of the German Language, Poetry, and Eloquence, and began his profitless exertions in behalf of the national drama. In 1734 he became professor of logic and metaphysics, and subsequently published his Erste Gründe der Weltweisheit (First Principles of Philosophy). He died in 1766. Gottsched is an example of the degree to which a writer may sink by partiality and pedantry, even when his intentions are laudable and his merit considerable. His opponents, Bodmer and his associates, who favoured the study of the English writers, laughed at his theories, mocked his pedantic style, and burlesqued his poetry; and he lost within his lifetime much of the influence he had acquired at the outset of his career. His zeal for the good of the German language was, however, of great use, and he at least perceived its capabilities, although he did not possess sufficient talents to exhibit its power in his own productions. This is his chief merit. Influenced by the example of Thomasius and Wolff, he substituted German in the class-room for the barbarous Latin which had hitherto been exclusively used in the teaching of philosophy and science. He was by no means suited for a reformer of the German drama. He wished to abolish the opera and comic opera, and to refine comedy by expelling from the stage the Merry Andrew, the amusing favourite of the multitude. The pieces which he himself prepared for the stage were stiff and prosy.

GOUDA (Dutch, *Ter Gouwe*), a town of Holland, in the province of South Holland, 11 miles north-east of Rotterdam, separated into two unequal parts by the Gouwe, which here unites with the Ijssel on the right bank. It is naturally defended by the ease with which the surrounding country, which is laid out in beautiful gardens, can be laid under water. The town is entered by five gates, is composed of neatly built houses, and every street, large and small, has a canal in its centre. The great market-place is the largest in Holland, the town-house in its centre a spacious, substantial edifice with a tower and spire. Other public buildings are —the prison, weigh-house, butter-house, and post-office. The Calvinistic church of St. John, founded in 1485, is noted for its painted glass windows, executed partly by the brothers Wouter and Dirk Crabeth, and said to be among the finest in Europe. This church contains the town library. The charities and benevolent institutions are various, including several hospitals. There are pipe-works, potteries, and breweries; cottons, parchment, leather, white-lead, stearine-candles, bricks, and tiles are made; and there are boat-building yards, snuff, corn, and other mills. Gouda, communicating directly by canal with Amsterdam, Rotterdam, &c., has a considerable transit trade. It is likewise a market for flax, but more especially for cheese, large quantities of which are brought here to the market, and sold under the name of Gouda cheese. There are several annual fairs. Pop. (1899), 22,192.

GOUGE, a chisel with a hollow or grooved cutting edge, used to cut channels or grooves in wood and stone.

GOUGH, HUGH, VISCOUNT, an English general, was the youngest son of Lieut.-col. George Gough, and was born at Woodstown, in the county of Limerick, in 1779. At the age of thirteen he obtained a commission in the Limerick militia. This was soon exchanged for a lieutenancy in the 78th Highlanders, which he joined at the Cape of Good Hope, and contributed to the capture of the Dutch fleet in the Bay of Saldanha. He then served in the West Indies in the 87th Regiment, and took an active part in the taking of Porto-Rico and Surinam. Having attained the rank of major, he was sent with his

regiment to the Peninsula in 1809, and distinguished himself by his bravery in the battles of Talavera, Barossa, Vittoria, and Nivelle, and in the defence of Tarifa. For his gallant conduct on these occasions he received a medal, and was created lieutenant-colonel. He became a major-general in 1830, and in 1837 went out to take command of a division of the Indian army. He had not been long there when he was ordered to proceed to China to take the command-in-chief of the British forces in that country. He held this command at the attack on Canton, and for his services on that occasion was created a G.C.B., received the thanks of Parliament, a baronetcy, and was raised to the rank of lieutenant-general. On the conclusion of the war he returned to India, and assumed the command-in-chief of the forces there, and in the following year suppressed, in a short, vigorous campaign, a serious revolt of the Mahrattas. In 1845 the Sikh war broke out, and it was not until after a deal of sanguinary fighting at Mudki, Ferozeshah, and Sobraon that this warlike tribe sued for peace (1846). For his signal services he was raised to the peerage as Baron Gough in April, 1846, and again received the thanks of Parliament. Two years later the Sikhs again took the field, and at Chillianwallah (13th January, 1849) Gough sacrificed many valuable lives, and obtained but a doubtful success. At home it was determined to supersede him in the command by Sir Charles Napier, but before the latter arrived in India Lord Gough had terminated the war by his splendid victory at Gujerat. He was raised to the viscountcy, and the East India Company settled a yearly pension of £2000 upon him, a like sum being added by government. After his return he never took part again in active service. He was made field-marshal in 1862. He died at St. Helen's, near Dublin, 2d March, 1869.

GOULARD'S EXTRACT, a solution in water of subacetate or basic acetate of lead. It is prepared by dissolving sugar of lead in water, and then boiling the solution with finely powdered oxide of lead for a certain time, filtering, and diluting to a definite strength. Its chief use is external, and it is applied either as a simple wash or in a poultice.

GOULBURN, a town in Argyle County, New South Wales, about 134 miles S.W. from Sydney. It is well laid out with broad thoroughfares, the chief buildings being the Anglican and Roman Catholic cathedrals, the court-house and the mechanics' institute. The industries include flour-mills, tanneries, breweries, boot and shoe factories, &c. The mineral wealth of the neighbourhood includes silver and copper, and there is also abundance of marble, slate and lime. Pop. (1901), 10,618.

GOURD, the popular name for plants of the genus *Cucurbita*, nat. order Cucurbitaceæ, and also for the different fruits produced by them. These latter are held in high estimation in hot countries; they attain a very large size, and most of them abound in wholesome, nutritious matter. The *C. Pepo*, or pumpkin, acquires sometimes a diameter of 2 feet. The *C. Melopepo*, or squash, is cultivated in America as an article of food. The *C. Citrullus*, or water melon, is also well known, and serves the Egyptians for meat and drink. The *C. aurantia*, or orange-fruited gourd, is cultivated only as a curiosity, and is a native of the East Indies. The *Lagenaria vulgaris*, or bottle gourd, a native both of the East and West Indies, is edible, and is often 6 feet long and 18 inches in circumference. The rind serves for drinking-cups, &c.

GOUROCK. See SUPPLEMENT.

GOUT, or PODAGRA, though a disease which, in its regular form, assumes the character of a local inflammation of a joint, is really a constitutional disease. Its cause seems to be the presence in the blood of excess of uric acid. This is a waste product of the combustion of nitrogenous foods in the body, which is excreted by the kidneys. To such a slight extent does it normally exist in the blood and tissues that very delicate tests are required to prove its presence. But in gout it has been shown to exist, and in much increased amount; and added to this is the fact that, though present in the system in excess, it is yet excreted by the kidneys in lessened amount, so that it accumulates in the system. The excessive production is due to some interference with the intricate chemical changes occurring in the tissues, whereby the nitrogenous principles of food do not undergo complete oxidation, and to derangement of the liver a great part in this interference is ascribed. The causes determining the failure of the kidneys to remove the waste product are still less understood. But while the exact determining causes are obscure, certain predisposing causes are well known. The chief of these are hereditary predisposition, and certain errors in diet, coupled with deficient exercise. That gout may be handed down from generation to generation is a well-established fact; and persons may thus acquire the disease in spite of every effort to prevent it. But it is equally true that gout may be acquired when no hereditary tendency exists. The errors in diet consist in the use of food too rich in nitrogenous principles, especially in the form of meat, in the excessive use of too highly seasoned dishes, and in the too free indulgence in certain alcoholic drinks. Port wine is specially regarded as a factor in the production of the disease, but all wines are more or less capable of exciting it, and malted liquors also. Whisky is less injurious in this respect. Men are more liable to the disease than women, and the age at which it most commonly appears is between thirty and forty years. The ordinary symptoms of an acute attack of regular gout are pain, inflammation, and swelling coming on usually during the night, and attacking one of the smaller joints, commonly that at the ball of the great toe, though any of the joints of toes or hands may suffer, and even the knee or elbow. The pain is intense, burning or tearing in character, and the heat and redness round the joint are marked. If the pain subsides towards morning it increases again towards night. Accompanying these signs of joint inflammation are chilliness or shivering at first, then fever, thirst, constipation, high-coloured scanty urine, restlessness, irritability of temper, and general digestive derangement. Often a patient knows when an attack is threatening by digestive derangements, irritability of temper, and a variety of other symptoms. The attack may last a week or ten days. However great may be the inflammation and swelling of the joint, suppuration is not to be feared. The attack tends to recur again and again, and many joints may become affected. With frequent attacks, the gout becomes chronic, and the joint undergoes changes, becoming stiff and deformed. A deposit of a chalky-looking material takes place into the tissues of the joint, forming the so-called *chalk-stones*, but consisting of urate of soda. When an acute attack of regular gout is suddenly suppressed or not fully developed, the disease is apt to show itself in irregular forms, in the shape of symptoms referable to the stomach and bowels, or the lungs, or the heart, or the nervous system. To such irregular forms the terms *retrocedent gout*, or *suppressed gout*, are applied. In time also chronic gout produces changes in various organs, liver, heart, kidneys, blood-vessels, &c. These are always grave complications. One of the chief elements in the treatment of gout is the dietetic; and much may be done in the direction of prevention

by a steady adherence to regular and simple habits of life.

GOVAN, a parish and police burgh of Scotland, in the county of Lanark. The burgh is on the left bank of the Clyde, to the west of Glasgow, of which it forms a suburb. From a quiet secluded village, it has latterly become the site of extensive shipbuilding yards, engineering works, large docks, &c. The part of the parish that lies south of the Clyde, and is now mostly in the municipal burgh of Glasgow, forms a parliamentary division of Lanarkshire, returning one member. Pop. of burgh (1871), 19,200; (1891), 63,625; (1901), 81,989.

GOVERNMENT is a word used in common speech in various significations. It denotes the act of governing, the persons who govern, and is often used elliptically for the phrase form of government, as when we speak of a monarchical or republican government. In the present article we shall concern ourselves exclusively with the last sense of the word.

It would be difficult to classify with any degree of precision the various forms of government which have sprung into existence since the human race leagued itself into communities. We may, however, borrow, as a starting-point, the classification of Aristotle. He divides the forms of government into three classes: —1st, Monarchy, or that form in which the sovereignty of the state is vested in one individual; 2d, Aristocracy, or that in which it is confided to a select portion of the community supposed to possess peculiar aptitude for its exercise; and 3d, Democracy, or that in which it is retained by the community itself, and exercised, either directly, as in the small republics of ancient Greece, or indirectly, by means of representative institutions, as in the constitutional states of modern times. Both the last forms have received the name of republican government. Each of these forms if brought into existence by the general will of the community, maintained by its consent, and employed for its benefit, is said to be a legitimate government; that is, a government which protects the interests of the collective body of the people without needlessly encroaching on individual liberty. But each of these legitimate forms was considered by the ancients to be liable to a particular form of corruption. Monarchy had a tendency to degenerate into tyranny, or a government for the special benefit of the single ruler; aristocracy became oligarchy—a government for the exclusive benefit of the governing class; and democracy degenerated into ochlocracy or mob rule—a government in which the majority, necessarily the rudest and most ignorant portion of the community, exercised a tyranny over the more refined and enlightened minority. Through each of these various forms, in the order we have mentioned them, each legitimate form being followed by its corresponding perverted form, government was supposed to run in a perpetual cycle; the last form, ochlocracy, being followed by anarchy, a state of things so abhorrent to the social and political instincts of mankind, as to induce them to revert speedily to monarchy, with the inevitable result of re-subjecting themselves to a similar series of misfortunes. As a means of avoiding these evils, a mixed government, that is, a form which should contain the elements of two at least, if not of all the pure forms, rejecting all the tendencies to derangement and degeneracy, is supposed to have been devised. The best species of mixed government was believed by Aristotle to be a union of aristocracy and democracy. Plato, in his laws, had shadowed forth a tripartite government, but the first writer in whose mind the practical importance of this latter form was fully present was Polybius, who, with Cicero, holds it to have been realized in the Roman constitution. The most remarkable instance of this form is, however, supposed to be seen in that balance of powers which forms the essence of the English constitution.

The question as to how far forms of government are a matter of choice on the part of a free people, or are dictated to them by influences beyond their volition, has been discussed by John Stuart Mill in his Representative Government. The conclusion he arrives at is, that men do not rise up on a summer morning and find these forms sprung up, neither do they resemble trees, which, once planted, keep growing while men are sleeping, but that in every stage of their existence they are made what they are by human voluntary agency. This absolute freedom of human choice *is* limited by three conditions: the people for whom the government is intended must be willing to accept it, or at least not so unwilling as to oppose an insurmountable obstacle to its establishment; they must be willing and able to do what is necessary to keep it standing; and they must be willing and able to do what it requires of them to enable it to fulfil its purposes. The failure of any of these conditions renders a form of government, whatever favourable promise it may otherwise hold out, unsuitable to the particular case. It may be stated that another general condition is necessary. The government must be adapted to the constitution of human nature, and recognize these arrangements of Providence over which the human will has no control. This seems so obvious, that it seems impossible to overlook it in fixing on a particular form of government, yet there is none which has been overlooked more frequently. The most prominent example is that in which a form is constructed on the assumption that all men are equal, the fact of nature being the opposite.

With the experience of a long series of ages it is somewhat disappointing to think that on an important subject like this mankind have not been able to come to any certain conclusion on what is absolutely and in itself the best form of government. One class of theorists would submit society to the absolute sway of a single individual if he possessed all the qualities they think necessary for his sphere. Others argue for a *laissez-faire* style of government, in which the liberty of the individual is looked to more than the collective good of the state; and others again sacrifice individual interests to those of the state. The end of government, which has been defined by the Utilitarian school as the greatest happiness of the greatest number, and by their opponents as the realization of the idea of humanity through the instrumentality of society, definitions which after all have their difference in mere words, seems equally attainable through the medium of a mixed representative and monarchical system, such as the English, or a purely republican form, such as the American.

GOVERNOR, a contrivance for equalizing the motion of machinery. See STEAM-ENGINE.

GOWER, JOHN, English poet, friend and contemporary of Chaucer, was born about 1325. Little is known with certainty of the events of his life, but he has been identified, with very great probability, with a John Gower who in 1368 received the manor of Kentwell, Suffolk, from his near kinswoman Joan Gower, daughter of Sir Robert Gower, a land-owner in the counties of Kent and Suffolk. Five years later he transferred the manor to others, and from that date he lived mainly in Kent. His most important work was dedicated to Richard II., at whose request he says it was written; but later he became a partisan of the Lancastrian Henry, who afterwards ascended the throne as Henry IV. He married in 1397. In 1400 he became blind, and in 1408 he died in Southwark. He was buried in the church of St. Mary Overies (now St.

Saviour's), to which he had been a munificent benefactor. Gower wrote three long poetical works in French, Latin, and English respectively. The French poem, entitled Speculum Meditantis, dealing with the vices and virtues of his time, was long believed to be irrecoverably lost, but was recently discovered in Cambridge University library. The Vox Clamantis is a Latin elegiac poem in seven books, dealing mainly with the Kentish phase of the peasants' revolt. It was edited for the Roxburghe Club by H. O. Coxe in 1850. Gower's chief poem, the Confessio Amantis (Lover's Confession), containing about thirty thousand lines, is in English, and is extant in two versions. The first, probably written about 1383, has a dedication to Richard II. and a concluding eulogy of Chaucer; the second, of some ten years later, is dedicated to Henry of Lancaster, and does not contain the lines referring to Chaucer. The poem proper comprises a prologue and eight books, and is mostly a dialogue between a lover and a confessor sent by Venus. No less than one hundred and twelve stories from Ovid, Statius, the Bible, the Gesta Romanorum, Geoffrey of Viterbo, Vincent de Beauvais, and other sources are introduced into the poem. Caxton printed the Confessio in 1483, and other editions appeared in 1532 and 1554. A good edition is that of Reinhold Pauli (3 vols., 1857), which Prof. Morley reprinted in 1888 with some alteration. A complete edition of Gower's works, edited from the manuscripts, with introductions, notes, and glossaries, by G. C. Macaulay, in 4 vols., has been issued from the Clarendon Press. The first volume, containing the Speculum Meditantis, appeared in 1899. Gower is polished and erudite, but prosy and tedious. His habitual graveness and sententiousness, even in dealing with light or trivial subjects, justify Chaucer's epithet of 'moral'.

GOWRIE CONSPIRACY, one of the strangest episodes in Scottish history, took place in August, 1600. Early in the morning of the 5th King James VI. and his retinue had assembled to have a buck-hunt in the Falkland Park in Fifeshire, about 12 miles from Perth. As the king was about to mount he was accosted by a young man of about nineteen years of age, Alexander Ruthven, the brother of the Earl of Gowrie; he succeeded in arousing the king's curiosity respecting a suspicious personage he had captured the previous night who had an urn of foreign gold pieces hid under his cloak, doubtless supplies brought from abroad to be distributed among the Roman Catholics by some trafficking priest. At the end of the hunt the king, accompanied by the Duke of Lennox, the Earl of Mar, and about twenty others accompanied young Ruthven to Gowrie House, the town's residence of the earl, which was situated in the suburbs of Perth, and where the prisoner was said to be confined. The king dined in a room separate from his followers, and after dinner was conducted by Ruthven up a dark winding staircase, which led to a small room in a turret in the south-east corner of the house, every door being closed and locked behind them as they passed. Instead of a chained captive the king saw before him an armed man; Ruthven instantly closed and locked the door, snatched a dagger from the man in armour's side and held it to the king's breast, saying, 'Sir, ye must be my prisoner; remember on my father's death.' The king expostulated with him, and he so far relented that he went to consult his brother. In a short time he returned, and exclaiming, 'By God! there is no remedy,' attempted to bind the king's hands with a garter. A desperate struggle ensued, in the course of which the king dragged Ruthven towards a window which looked out to the road and shouted for help. His attendants, who had a few minutes before been startled by the announcement of one of Gowrie's servants that the king had left the castle by a back gate, had just assembled on the road beneath the window and recognized the king's voice. Lennox, Mar, and the greater number of the royal retinue rushed up the principal staircase, but were stopped by the bolted doors, Sir John Ramsay, one of the king's pages, effected an entrance to the room by a back staircase, stabbed Ruthven twice, and threw him down stairs, where he was despatched by Sir Thomas Erskine and Sir Hugh Herries. Hearing of his brother's death, the Earl of Gowrie rushed into the room with seven servants well armed, but quickly received a mortal thrust from Ramsay. Meanwhile wild rumours of the exciting struggle had got circulated in Perth, which became excited into high uproar. The inhabitants, by whom Gowrie, who was their provost, was much beloved, ran to arms to the sound of the common bell, and surrounding the house, threatened revenge on the green-coats (the king's party). The king addressed them from a window and admitted the magistrates, to whom he fully explained all the circumstances, on which they quietly dispersed, and the king returned in safety to Falkland. Three of the earl's servants were executed at Perth. Andrew Henderson, the man in armour, who had taken no great active part in the affray, was pardoned, and the Gowrie estates were confiscated. All who were examined were completely ignorant as to the motives of the two brothers, and they still remain in some degree of mystery. The current belief is that the conspirators intended to obtain possession of the king's person, to convey him by water to Fastcastle, and either give him up to England or administer the government in his name in the interest of that country and in that of the Presbyterian leaders at home. It is held by other authorities, however, that their object was merely to avenge their father's death, who had been executed a few years previously.

GOYAZ, a province or state of Brazil, which extends from 42° to 52° w. lon., and from 6° 30′ to 20° s. lat.; area 263,362 square miles. Chief town, Goyaz, formerly called Villa Boa. The chief occupation of the inhabitants, now that the gold mines (discovered in 1726) are about exhausted, is cattle rearing and agriculture. The inhabitants are however so indolent that with a large and fertile country at their disposal they only raise sufficient food for their own consumption. Pop. (1890), 227,572.

GOZO, or Gozzo (ancient *Gaulos*), an island of the Mediterranean, belonging to Britain, about 4 miles north-west of Malta; length, 9 miles; breadth, 5 miles; area, about 30 square miles. The coast is rocky and surrounded with shoals; the interior is also rocky and very scantily covered with soil, which, however, is of great natural fertility. A good deal of grain and fruit is raised; but the most important crop is cotton, and the spinning of it is the most important employment. Cattle of superior quality are reared, and the island is celebrated for a breed of large asses. The chief town, Victoria, contains about 3000, and the whole island (1891), 18,680 inhabitants. The island appears to have been formerly connected with Malta, and on this account and from its natural productions it is a spot of great interest to the naturalist; the antiquary's attention will be arrested by the cyclopean walls of the Giant's Tower, and later Roman remains; while the sportsman will find plenty of exercise for his skill in the game which abounds.

GRAAF, RÉGNIER DE, a celebrated Dutch physician, born in 1641 at Schoonhove. He studied medicine at Leyden under Dubois (De le Boé), better

known under his Latinized name Sylvius, and made such rapid progress that at the age of twenty the pupil would have been called to occupy the chair rendered vacant by his master's death had not his religion (he was a Catholic) stood in his way. A few years later he went to France, received his doctor's degree at Angers, and then went to Paris, where he rapidly rose in the esteem of the learned. On his return to Holland he settled at Delft, where his successful professional career gained him much envy. Several works of his on the nature and functions of the pancreatic juice, and more especially on the organs of generation in both sexes, brought him into violent collision with Swammerdam; and it is said by Haller that the excitement caused by this quarrel was the direct cause of his death, which took place at Delft in 1673. Although some of his notions are erroneous, such as that the pancreatic juice is acid, and that most diseases, particularly intermittent fevers, are the result of a morbid state of this liquid, still he has rendered great service to his art by the invention of those injections of the blood-vessels which Swammerdam and Ruysch brought to a state of comparative excellence, and which are the basis of our sound knowledge of most of the tissues of the body. His works were first collected and published in one octavo volume at Leyden in 1677, and afterwards at Amsterdam in 1705.

GRAAFF-REINET, a division and town, Cape Colony. The division is bounded on the north by Murraysburg and Richmond; east by Middelburg, Cradock and Somerset; south by Uitenhage; west by Beaufort and Prince Albert. In the north-east it contains a portion of the Sneeuwbergen or Snow Mountains, and from this elevated region proceed head streams of the Sunday River and Great Fish River. Great numbers of cattle are raised, the district being principally devoted to grazing. Area, 3792 sq. miles. Pop. 20,145.—The town, capital of the division, is situated on Sunday River, 160 miles north of Port Elizabeth (with which there is railway connection), and its central position between Port Elizabeth and the northern boundary of the colony renders it one of the most flourishing of interior towns. There are churches and schools of the English Episcopalian and the Dutch Reformed denominations, a town-hall, a public library, a college, hospital, botanical gardens, &c. It is regularly laid out, and contains vineyards and orchards. Pop. 7000.

GRAAL (called more fully the Holy or San-Graal), a word neither the orthography nor etymology of which can be determined. It is spelt Grail, Greal, Grasal, Grazal, Grial, Gréale, Grayle, and San Greal, Seynt Graal, Sang Real, Sank Ryal, &c. It is said to be derived from the Old French *Gréal*, which has been identified with the Low Latin *Gradale*, which signifies a cup or drinking dish; or from *sang réal* (royal blood, or blood of our Lord). The legend in which the cup and blood are combined runs somewhat as follows:—The Holy Cup or Graal was brought from heaven by the angels; or according to another version, was a present of the Queen of Sheba to Solomon. It was it that Christ drank from at the Last Supper; it was afterwards stolen by one of the servants of Pilate, who used it on the occasion of washing his hands of innocent blood before the multitude; and it was given by him to Joseph of Arimathea, who collected in it the Holy Blood which fell from the wounds of Christ on the cross. A few days after the resurrection Joseph was seized by the Jews, and subjected to an imprisonment of forty-two years, during which period he was fed without human sustenance by the Holy Graal, miraculously restored to him on his incarceration. He was at length released by Vespasian, whom he converted and baptized. After many journeyings in various lands, where he converted the kings and their subjects, he arrived in Britain, where he settled and founded the first Christian oratory in England. On his death he confided the care of the Graal to his son, who in like manner consecrated one of his relations in his place as custodian of the sacred treasure. In the course of time, through the sins of its keepers, it was caught back into heaven, where it was preserved until there should appear on earth a race of heroes worthy to resume its guardianship. The chief of this line was an Asiatic prince, Perillus, who came to Gaul, where his descendants allied themselves with the family of a Breton sovereign. Titurel, who sprang from this lineage, was the one chosen of God to found the worship of the Graal amongst the Gauls. The chalice was brought to him by angels, who instructed him in its mysteries. In its honour Titurel erected a temple on the model of that at Jerusalem, and organized a band of guardians of the vessel. It was visible only to the baptized, and of these only the pure in heart and morals. Oracles were given by the Graal, expressed in characters which appeared for a short time on the surface of the bowl. Spiritual strength, a foretaste of heaven, attended the custody and vision of the vessel, which stood to its worshippers in place of food or drink, which maintained them in perpetual youth, and imparted a comparative immunity from wounds or death. With this legend the stories of Arthur and his Knights of the Round Table were subsequently connected. Three of these knights—Galahad, Percival, and Bors or Bohors—set out in quest of the Graal, and were blessed with the sight of it at the castle of King Pelles at Mount Salvage, where it was given over to the custody of Galahad, who was instructed to carry it to the city of Sarras, and at his death to confide its keeping to Percival. On the death of this last-mentioned knight the cup was taken up into heaven. The earliest writers on this subject are Chrétien de Troyes, Walter Mapes of Oxford, and Wolfram von Eschenbach. See Furnival's edition of La Queste del Saint Graal; Baring-Gould's Curious Myths of the Middle Ages; Nutt's Studies on the Legend of the Holy Grail (1888); G. Paris in Histoire Littéraire de la France (vol. 30, 1888); Rhys's Arthurian Legend (1891).

GRACCHUS, Tiberius Sempronius and Caius, two Romans, who, by undertaking to reform the republic, and to place the national welfare upon a firm basis, awakened popular commotions in Rome, of which they themselves became the victims. Tiberius Sempronius, born about 169 B.C., who was about nine years older than his brother, was a man of great talents, honest and upright. Both he and his brother having lost their father early, received from their excellent mother Cornelia, the daughter of the great Scipio the elder, a careful education. At a more advanced age their minds were formed and ennobled by the Greek philosophy. Their family was among the most distinguished in Rome. Tiberius early made himself conspicuous in the military service. Under the command of his brother-in-law, the younger Scipio, he served at the siege of Carthage, and was the first man who mounted the walls. While he was yet a mere youth he was received into the College of Augurs—an honour usually conferred only upon distinguished statesmen. He was subsequently quæstor to the Consul Mancinus, who at that time waged war against the Numantines in Spain—few in number, but brave, and attached to their liberty. Here the high character of the young Gracchus, even with the enemies of Rome, enabled him to conclude a treaty with the

Numantines after the defeat of Mancinus' army, which, without being disgraceful to the Romans, secured to the Numantines their independence. The Numantines even returned to the quæstor his accounts and papers, which they had taken among the Roman baggage, with touching marks of their esteem. But the Roman senate refused to ratify this treaty, and, to atone in some measure for this breach of the law of nations, decreed that all who had been concerned in its negotiation should be delivered up to the Numantines. They also sent the younger Scipio with a new army against Numantia. The high character which Gracchus had already obtained delivered him from the ignominious treatment contemplated in the decree; and finally only Mancinus was given up, and even he was dismissed uninjured by the Numantines.

This transaction gave a direction to the whole political life of Gracchus, and tended much to make him an opponent of the senate and a supporter of the cause of the people. In 133 B.C. he offered himself as a candidate for the tribuneship, which office rendered his person inviolable so long as he was invested with it, and placed him in a situation to advance his great plans for the improvement of the condition of the people in a legal way. The poverty of the greater part of the sovereign people of Rome, which he had particularly noticed in his last journey from the province to the capital, inspired him with the design of increasing the number of landed proprietors in Italy, and thereby applying a remedy to the poverty of the mass of the people, and the greatest evils under which the republic suffered. As the Romans were not fond of innovations he sought to obtain his object by the revival of an old law passed 232 years before, but long forgotten. At that time it had been decreed, on the proposition of the tribune of the people, Licinius Stolo, after violent contentions on the subject, 'that no one should possess more than 500 acres (*jugera*, each 28,000 square feet) of the public domains (*ager publicus*), and that the overplus should be equally divided among the plebeians.' This law, which was now called, after Gracchus, the *Sempronian*, or, by way of eminence, the *agrarian law*, he revived, but with the introduction of several softening clauses. The possessors of surplus land were to receive compensation for the buildings erected on it and other improvements; every son who was of age might possess the whole quantity allowed by law to a citizen and householder; and every son under age might possess half that quantity (250 jugera). Nevertheless the proposition of Tiberius Gracchus was met with the most determined opposition by the ruling party, the nobles or patricians. Besides, the Italian nations were also injured by it. They had, since their submission, under the name of *allies of the Roman people*, contributed greatly to the advancement of the Roman power by their supplies of money and troops; and they had, under various titles, acquired rights to many tracts of the Roman public lands. It is probable that Tiberius promised, by way of indemnification to some of them, especially the Latins, the rights of Roman citizenship, and to all better protection against the extortions of the Roman magistrates. To counteract his plans the senate gained over one of the tribunes, Marcus Octavius, a young, rich, and daring man; and when Tiberius, after having, according to custom, exposed his law nineteen days to the public view, proceeded to take the votes of the assembled people upon it, Octavius interposed with his veto, and thus seemed at once to have defeated the whole undertaking. Tiberius now exerted all the prerogative of his office, sealed up the treasury, and forbade all the authorites the discharge of their several offices. He saw, however, that this was of no service to his plan. He therefore took a step till then unheard of in Roman history. At the next assembly of the people he proposed the expulsion of Octavius from his office, as faithless to the cause of the people. Seventeen of the thirty-five tribes had already voted for his expulsion, when Tiberius approached Octavius (who had been the friend of his youth), and begged and adjured him to withdraw his veto. Octavius bade him proceed in taking the votes; and hardly had the next tribe given their voice for his expulsion when the infuriated populace rushed upon him, he having now lost the inviolability of his person with his office. The exertions of Tiberius, who spared no pains to moderate the fury of the people; the fidelity of a slave, who sacrificed himself for him; and the efforts of the aristocratic party, were scarcely able to save his life. The same assembly passed the law of Tiberius, and three commissioners were appointed to carry it into execution, namely, Tiberius himself, his brother Caius, and his father-in-law Appius Claudius. All the difficulties which stood in the way of the law now appeared in their full light. Even the preparatory business of ascertaining which was public land, and which private property, was found to have its full share. Outcries and complaints were made from every part of Italy. Thus the popularity of Tiberius began to sink, and his adversaries did not remain inactive.

Things were in such a state when June of the following year came on, in which the tribunes for the next year were to be elected; and Tiberius, who had endeavoured to regain the favour of the people by some new propositions, offered himself again as candidate for the office. The aristocrats used every effort to prevent his election, and the ferment in Rome was carried to the highest pitch. One election day went by without any election being made. On the next a vast multitude beset the forum, and the senate assembled in the neighbouring temple of Faith (*Fides*). Tiberius strove in vain to speak to the raging populace. To express to them that his life was in danger, he touched his head. Immediately his enemies exclaimed that he sought a diadem. The accusation was groundless, almost ridiculous. Scipio Nasica, a member of one of the most distinguished families, who had been consul—a great land-owner and a violent aristocrat—arose, and called upon the consuls to use force. When they refused, he called out, irritated to fury, 'Whoever loves the republic, let him follow me!' and, with his followers, rushed from the curia in haste. A great multitude, consisting principally of senators and persons who had been magistrates, armed themselves with clubs and similar weapons, and made an onset upon the people, who gave way before them, few making any attempt to defend themselves. In the tumult which followed Tiberius himself, with 300 of his followers, was slain. But this first shedding of the blood of citizens was not sufficient to allay the ferment which had been excited. A democratic party was formed in opposition to the senate, and considered itself justified in proceeding to extremities. The boldest speakers pressed into the tribuneship, and disguised their ambitious projects under the revered name of Gracchus. In this way the tribune of the people, Carbo, two years after the death of Tiberius, disturbed the quiet of the state with new propositions. He subsequently rejoined the aristocratic party. Another principal man among the people, Fulvius Flaccus, even became consul, and while in that high office would have excited great troubles by the large promises which he made to the allies had not the senate given him a command in Gaul. The execution of the Sempronian law, too, which still continued, the law being in no way affected by the death of Tiberius, afforded con-

tinual occasion for fresh commotions. The place of the murdered Tiberius was filled by Licinius Crassus, father-in-law of Caius Gracchus; and on his death Carbo, Fulvius Flaccus, and Caius Gracchus constituted the committee appointed for the enforcement of the law.

In this way the parties had struggled with varying success, when, ten years after the death of his brother Tiberius, the younger Gracchus obtained the tribuneship. With more various and shining talents than his brother, he united a stormy eloquence, which carried away his hearers. In the discharge of his office as tribune he first of all renewed his brother's law, and revenged his memory by expelling many of his most violent enemies from the city. At the same time he carried through a law 'that every month corn should be sold to the poor at a low fixed rate,' and by another law effected some alleviations in the rigour of the military service, and insured for the soldiers clothing, besides their pay. He also caused some additional highways to be run through Italy. The people were animated with an unlimited enthusiasm for their favourite; his enemies were terrified and weakened; hence he obtained the renewal of his office for the following year with ease. His attempt to introduce three hundred knights into the senate failed; but on the other hand, at his proposal the administration of justice was taken from the senate and transferred to the equestrian order. This gave rise to a new political power in the Roman commonwealth, which, holding a station intermediate between the senate and the people, had a most powerful influence in its subsequent history. The senate now resorted to a new but sure means of destroying Caius. Livius Drusus, a tribune gained over to their interests, had the art to withdraw the affections of the populace from Caius by making greater promises to them, and thus obtained a superior popularity for himself and the senate. Hence it resulted that Caius did not obtain a third tribuneship, and Opimius, one of his bitterest enemies, was chosen to the consulate. A tumult, in which a lictor of Opimius was killed, gave the senate a pretence for empowering the consuls to take strong measures. A proposition which Opimius made to the people for the repeal of a law of Gracchus (it only related to a colony at Carthage which he had procured to be decreed, but it was used as a test of the repeal of all the laws which had been passed by the Gracchi) increased the ferment. Gracchus appeared upon the forum, and Flaccus, his friend, had his followers armed. Upon this Opimius made an attack upon the people with a well-armed band of disciplined soldiers. Nearly 3000 were slain, and Gracchus himself, although bravely defended by some faithful friends, fell a sacrifice to the rage of his enemy. The agrarian law was some time after repealed; but the reverence of the people for the senate was destroyed.

GRACE, in the general acceptation of the term, is the gratuitous favour of the powerful towards the weak. In theology it is the disposition with which God communicates his ordinary benefits to us (common or general grace); and, in its restricted sense, the inclination and efficiency which he evinces for our recovery and salvation (special or saving grace). It is of grace in the latter sense that the following remarks treat.

Before the fifth century little attention was paid to the dogmatic question of grace and its effects. It had merely been occasionally hinted at by the fathers of the Greek Church. Pelagius, a native of Britain, having used some free expressions, which seemed to attribute too little to the assistance of divine grace in the renovation of the heart of man, and too much to his own ability to do good, Augustine undertook an accurate investigation of this doctrine, with a zeal congenial to his ardent nature. He said that 'man is by nature corrupt, and incapable of any good, and absolutely unable to do anything for his own renovation; that, as he cannot even will that which is good, everything must be effected by the internal operation of grace upon the heart.' Hence, to be consistent with himself, he came to the opinion, which has since been so much discussed, that God, of his own free-will, has foreordained some to eternal felicity and others to irrevocable and eternal misery; that, in consequence of this decision, all children that die unbaptized, and even those among the baptized not ordained to eternal life before they die, although they have committed no actual sin, are condemned without hope of deliverance; but that no one on earth knows who, of professed Christians, have been elected or who have been reprobated, and every one ought to give himself up to the inscrutable will of God. In accordance with this view of Augustine, and the obvious sense borne by many passages of Scripture, is the doctrine of predestination, which among teachers of religion in the church, from the fifth century to the times of the Reformation, and subsequently, has been a subject of warm discussion. The majority of those who are designated Catholic or Orthodox coincided with Augustine, and, with him, pronounced the Pelagians heretics, for holding that human nature is still as pure as it was at its first creation, that all the corruption which prevails is in no way connected with the sin of our first parents, being the effect, not of any superinduced degeneracy, but of the influence of bad example, and that, consequently, man being sufficient for his own purification, has no need, at least, of preventing grace.

We may, therefore, justly call Augustine the leader of the long succession of western theologians, who, by their unyielding perseverance in the Augustinian doctrines concerning an unconditional election, long successfully resisted the attempt to introduce what was speciously termed a rational theology. Many, however, especially the French theologians, imagined that Augustine had gone too far, and followed the example of the Abbot Cassianus, of Marseilles, who, in a book written about the year 420, had adopted a middle course, in order to reconcile the operations of grace and free-will in man's renovation, by a milder and more scriptural mode. He considered the predestination of God, in respect to man's salvation, as a conditional one, resting upon his own conduct. His followers were named *semi-* or *half-Pelagians*, though the Catholic Church did not immediately declare them heretics, as this church left the doctrine of predestination in the main undetermined.

Subsequently, the singular spectacle of a gradual change of sides was exhibited. On account of the increasing ignorance of the clergy, the doctrines of Augustine concerning an unconditional and particular election, fell into oblivion, notwithstanding the reverence paid that saint; and therefore it was not difficult for the scholastic theology of the middle ages so to pervert him, that he should appear easily reconciled to the Pelagians. As early as 848 Gottschalk, a fugitive monk of Fulda, was pronounced a heretic by the synod at Mentz, on account of his adherence to the Augustinian dogma, and condemned to prison for life. At the disputation which the Catholic Dr. Eckius held with Martin Luther's friend Karlstadt, in 1519, at Leipzig, the latter defended the opinion of Augustine concerning divine grace, while Eckius opposed to him the views of St. Thomas Aquinas, which some theologians regard as *semi-Pelagian*. The Lutherans, in the meantime,

approximated to the Catholics with respect to this doctrine; while Calvin and Beza, and the great body of their followers, returned to the fundamental principles of Augustine, and made an unconditional divine predestination for the salvation of some men, and the exclusion of others, an essential part of the creed of the reformed church. The evangelical Lutherans, on the other hand, in their Formula of Concord, admitted that God had ordained all men to eternal felicity, but knew beforehand who would render themselves unworthy of it, and consequently, that election concerned only really good men, and would be the cause of their salvation.

In the meantime, however, the Catholics had not come to an agreement concerning this dogma. This appears from the quarrels of the Dominicans and Jesuits, the latter of whom, on account of their moderate views of the doctrine of election and the power of free-will, were charged by the former with Pelagianism. This was particularly the case with the Jesuit Lewis Molina, in 1588, from whom the Molinistic disputes in the Netherlands received their name.

In the seventeenth century, also, two new parties, which had their origin in the dispute concerning the doctrine of predestination, sprang up in the Netherlands, namely the Arminians (which see) or Remonstrants, among the Protestants, and the Jansenists among the Catholics. The former held to a universal and conditional divine predestination for the salvation of all men, in opposition to the strict Calvinistic party, from whom, in 1610, they formally separated themselves. The latter, in consequence of the revival of the Augustinian system of doctrines by Bishop Jansen (who died in 1638), in a dispute with the Catholic Church, which was then under the influence of moderate Jesuits, adopted the idea of a twofold and absolute divine predestination for the salvation and damnation of men. From that time the members of the Christian church have continued to differ upon this subject.

GRACE, Days of. See Bill—Bill of Exchange.

GRACES (Greek, *Charites*, translated by the Romans *Gratiæ*), the goddesses of grace, from whom, according to Pindar, comes everything beautiful and agreeable, through whom alone man becomes wise and glorious. According to Hesiod, and most poets and mythologists, Zeus was their father. Hesiod calls their mother Eurynome; and most of the ancients agree with him in this point. The Lacedæmonians and Athenians at first knew of but two Graces, whom the former called *Phaënna* (the brilliant) and *Kleta* (the glorious); the latter, *Hegemone* (the leader) and *Auxo* (the propitious). King Eteocles introduced the worship of three Graces among the Orchomenians, and Hesiod gives them the names of *Aglaia* (brilliancy), *Thalia* (the blooming), and *Euphrosyne* (mirth). Homer mentions them in the Iliad as handmaids of Hera (Juno), but in the Odyssey as those of Aphrodite, who is attended by them in the bath, &c. He conceived them as forming a numerous troop of goddesses, whose office it was to render happy the days of the immortals. According to Hesiod they were an emblem of the disposition to please, and to render social intercourse agreeable by gayety and politeness. Later poets considered them as allegorical images. The Graces always appear as attendant, never as ruling deities. They do not conquer hearts, but Aphrodite conquers them through the Graces; they do not adorn themselves, but they adorn Aphrodite. They not only improve corporeal charms, they have an influence also upon music, eloquence, poetry, and other arts; and the execution of acts of benevolence and gratitude is likewise superintended by them. In the earliest times the Graces were represented entirely covered; the gold statues of Pupalus in Smyrna, and the marble ones of Socrates at the entrance of the Acropolis, at Athens, represented them clothed. The same was the case with the statues in the temple of Elis. One of them held a rose, another a branch of myrtle (symbols of beauty and love), the third a die (the symbol of sportive youth). In later times they were represented naked, and holding each other's hands or embracing. They had many temples in Greece, partly dedicated to them alone, partly in common with other deities, particularly Aphrodite, the Muses, Eros, Hermes, and Apollo. Their festivals were called in Greece *Charisia*. It was customary to swear by the Graces, and libations of wine were offered them at meals. The most celebrated Graces of modern sculpture are those of Canova and Thorwaldsen, productions which would alone render those two great artists immortal.

GRACIOSO, the theatrical name for a Spanish buffoon or droll; a standing character in Spanish pieces, like the *Hanswurst* of the German comedy, or the English *clown*. This character occurs under different names, in all three species of the Spanish comedy, but especially in the pieces of intrigue (*comedias de capa y espada*). His pattern is to be found in the Sosias of Plautus, or in the Davus, or other characters of slaves, in Terence. These personages are rarely used as agents to involve the plot by their intrigues, but are principally employed as servants to parody the motives that actuate their master, which they often do in a most agreeable and witty way. In the plays of Augustin Moreto especially, this part is remarkable for happy strokes of wit.—In music, *gracioso* is the direction to give a passage a soft agreeable expression.

GRADIENT, in railway engineering, is a term used to signify the departure of the line from a perfect level. In England the degree of slope is usually expressed as a fraction of the length: thus 1 in 250 signifies a rise or fall of 1 foot in 250 feet measured along the line. In America it is given in feet per mile. In heraldry a tortoise walking is said to be gradient.

GRADUAL (Latin, *graduale* or *gradale*), the psalm, anthem, or hymn, which from a remote antiquity has been said or sung in the service of the Roman Catholic Church between the Epistle and the Gospel, and which derives its name from being anciently chanted on the steps (*gradus*) of the ambo or pulpit, or of the altar. By an easy transition the name gradual was frequently applied to the Antiphonary, the book which contained the hymns, anthems, or verses to be chanted or sung, and which was originally one of the three service books of the church. About the eleventh or twelfth century it was found convenient to unite the other two (the Sacramentary and the Lectionary) with the Gradual in one volume, called the Book of Missæ, or Complete (or Plenary) Missal. The title Psalmi Graduales, or Psalms of Degrees, is given to the fifteen Psalms, cxx.–cxxxiv. (cxix.–cxxxiii. in the Vulgate), some of which are believed to have been written on the return from the Babylonish captivity, and which, being distributed into three equal groups, form part of the office of each Wednesday during Lent.

GRADUATION, the art of dividing mathematical, astronomical, and other philosophical instruments. It is performed in two ways, either by making a copy of a system of divisions already existing, or by original dividing. The straight scales and rules in common use are thus divided:—the pattern or standard scale, and the one on which the copy is to be made, are placed side by side; a straight edge,

with a shoulder at right angles, like a carpenter's square, is made to slide along the original, stopping at each division, when a corresponding mark is cut by the dividing knife on the copy. The original graduation of a straight line into equal parts, as in making a first standard scale, is performed by bisection or stepping. In bisecting the points of a beam compass are adjusted to nearly half the length of the line to be divided; one point is then placed at one end of the line, and a faint arc struck towards the middle; this is repeated at the other end; the small distance between the two arcs is then bisected with the aid of a fine pointer and magnifier, which gives the half of the line. The half thus obtained is bisected in like manner, the quarters bisected again, and so on until the required subdivision is attained. Stepping is performed with delicately pointed spring dividers, which are set at first as nearly as possible to the opening of the small division required; the points are then made to step on leaving at each stop a faint dot, and when it is found that the last step either falls short of or overpassses the end of the line, the opening is adjusted accordingly, until perfect accuracy is obtained. The mode of bisection is practically the most accurate, and has been adopted by Graham, the Troughtons, Bird, Ramsden, and other eminent artists. Curved lines are divided on this principle; the chord of an arc of 60° is equal to the radius; therefore the opening of the compasses required for striking the circle gives this arc at once to start with. An arc 90° is obtained by bisecting 60° and adding the half; by continual bisection of 60° the finer graduations are produced. The methods of original graduation are not practically adopted, except for the largest and most important astronomical or geodesical instruments. Ordinary instruments are graduated by dividing plates or engines, which copy and adapt a series of already existing divisions. The dividing plate which is used for the graduation of compass rings and other common purposes, is a divided circle with a steel straight-edge, made movable on the axis of the plate in such a way that its edge, during every part of its revolution, shall fall in the exact line from the centre to the circumference. The ring or other instrument to be divided is clamped upon the plate with its centre exactly coinciding with that of the plate, and the straight-edge is moved round, and made to halt at the required divisions on the circumference of the dividing plate, and by using the straight-edge as a guide corresponding divisions are marked off upon the concentric arc of the instrument to be divided. The dividing engine is a very complicated machine, requiring great care and nicety in its construction. The general principle of the engine may be understood from the following brief description of Ramsden's machine:—A horizontal circle of 4 feet diameter turns upon a vertical axis; the outer edge is notched by an endless screw, one revolution of which carries the circle round 10′; the pressure of the foot upon a treadle turns the screw forward, and there is a series of very ingenious contrivances which enable the divider to turn the screw through any portion of its revolution at each descent of the treadle, and which restore the position of the parts when the foot is taken off, without allowing any return motion to the screw. The divisions are usually cut on an arc of silver, gold, or platinum, which is inlaid upon the limb of the instrument; the precious metals being used on account of the oxidization to which the common metals are liable. Among the other celebrated dividing engines we may mention besides Ramsden's those of Simms, Ross, Troughton, and Jones.

GRÆCIA MAGNA. See MAGNA GRÆCIA.

GRÆVIUS, or GRÆFE, JOHANN GEORG, a learned classical scholar, born at Naumburg, in Saxony, in 1632. Such was his ardour for study that, while at school, he sometimes passed the greater part of the night in reading the works of Homer and Hesiod. He then went to the University of Leipzig, and afterwards to Amsterdam. At the age of twenty-four he was appointed professor at Duisburg, and subsequently succeeded Gronovius at Deventer. Thence he was invited, by the States of Utrecht, to become professor of politics, history, and rhetoric in their university, which station he filled with great reputation during forty-one years; he also held the office of historiographer to the King of Great Britain, William III. He died in 1703. His literary productions consist of valuable editions of the Epistles and Orations of Cicero, and of the works of Florus, Cæsar, Suetonius, Hesiod, &c.; besides two large and valuable collections—Thesaurus Antiquitatum Romanarum (twelve vols. folio), and Thesaurus Antiquitatum et Historiarum Italiæ (six vols. folio), afterwards continued by Peter Burmann. Grævius displayed little of the pedantry and arrogance which too often deform the character of the critic, and was deservedly esteemed both as a man and a scholar.

GRAFFITI, the name given by archeologists to the rude designs and inscriptions of popular origin drawn or engraved with the style upon the walls of ancient towns and buildings, particularly of Rome and Pompeii. Many of these are valuable for the light they throw on popular habits and modes of thought, and the illustrations they often in consequence afford of ancient authors. Graffiti have been found in Greece and Egypt as well as in Italy, but they are more numerous in Pompeii and Rome than elsewhere. Some are traced with chalk or plaster, but the majority are scratched on stone or plaster with the stilus, which helps to account for their preservation. Those in Pompeii are found in the Latin, Greek, and Oscan languages, showing that the ancient language of Campania was still extant among a portion of the populace. The inscriptions are most frequently amatory or humorous, sometimes malicious or obscene. In Rome they occur frequently in the catacombs, particularly of Sta Agnese and San Calisto. Many of these are by Christians, some by Pagans, in ridicule of Christianity.

GRAFTING is one of the modes of propagating plants artificially, by which varieties are preserved and increased, and fruit-bearing facilitated. It is an operation by which a bud or scion of an individual plant is inserted upon another individual, so as to become organically united with the stock on which it has been placed. Grafting can only take place between plants which have a certain affinity, individuals of the same species, genus, or order; as unless there is a similarity between the sap of the individuals the union cannot be effected. The graft does not become identified with the stock to which it is united, but retains its own peculiarities of variety or species. The parts between which it is effected must be actively vegetating. The union of the parts is effected by means of the proper juice of the vegetables, which becomes solidified and organized in the same manner as the animal lymph is coagulated in the healing of a wound. The advantages derived from grafting are the preservation of remarkable varieties, which could not be reproduced from seed; the more rapid multiplication of particular species, and the anticipation of the period of fructification, which may thus be advanced by several years. The principal methods of grafting are—1. *By approach.*—This process is intended to unite at one or more points two plants growing from separate roots. Plates of bark of equal size are removed, the wounds are kept together and protected from air. Stems,

branches, or roots may be united in this way. 2. *By scions.*—Consists in removing young twigs, and sometimes roots, from the parent plant and uniting them to another. The grafts are separated days or even months before the operation is performed, and are kept alive by immersing the extremities in water or earth, in order that the flow of sap may be reduced in them below that of the stock in which they are to be placed. The head of the stock is generally cut off before inserting them. Sometimes it is cut close to the ground. Sometimes the twig is inserted in a slit. This is called cleft-grafting. Sometimes the bark is separated and a circle of twigs inserted between it and the woody layers. This is called crown-grafting. Peg-grafting is inserting a young branch into a perforated trunk. It is now seldom practised. When a notch is cut in the side of the stock instead of cutting off the head, it is called side-grafting. 3. *By buds.*—This consists in transferring to another stock a plate of bark, to which one or more buds adhere. Bud-grafting is the most commonly practised, especially for multiplying fruit-trees, owing to the facility with which it may be performed. Scutcheon-grafting, flute-grafting, and other varieties may be referred to it. (See BUDDING.) 4. *Grafting of herbaceous parts of vegetables.*—This method of grafting may be performed with annual plants, or with the young herbaceous shoots of trees during the full flow of the sap. The graft must be inserted into the axilla, or into the vicinity of a living leaf of the stock. The leaf serves to draw the sap into the graft.

GRAGNANO, a town, Italy, province of, and 19 miles south-east of Naples, in a plain. It contains several churches, one of them collegiate, and a convent, and has manufactures of woollen cloth, and two annual fairs. Pop. 11,243.

GRAHAM, GEORGE, a celebrated mechanician and watchmaker, and one of the most accurate artists of his day, was born at Kirklington, in Cumberland, in 1675. He came to London, and was received into the family of Tompion, a celebrated watchmaker, whom he succeeded in business, and he invented several astronomical instruments, which much advanced the progress of science. He was a member of the Royal Society, and constructed the great mural quadrant in the observatory at Greenwich. He also constructed a planetarium in 1715, from which model most succeeding orreries have been formed. He invented a compensation pendulum, and also the dead-beat escapement still in use. He died in 1751. See DEAD-BEAT ESCAPEMENT.

GRAHAM, JAMES. See MONTROSE (MARQUIS OF).

GRAHAM, JOHN, VISCOUNT DUNDEE, commonly known as Claverhouse, was the eldest son of Sir William Graham of Claverhouse, whose family was allied to that of Montrose. He was born about 1650, and educated at St. Andrews. His letters do not show signs of much cultivation, but he is said to have been distinguished for his proficiency in mathematics, and for his love of Highland poetry, and to have recommended himself to Archbishop Sharpe by his zeal for the established order in church and state. He went abroad and entered the service, first of France and afterwards of Holland, but in consequence of his failing to obtain the command of a Scottish regiment in the Dutch service he returned to Scotland in 1677, where he was appointed captain of a troop of horse raised to enforce compliance with the establishment of Episcopacy. He distinguished himself by an unscrupulous zeal in this service, and waged an exterminating war against conventicles. The murder of Archbishop Sharpe in May, 1679, redoubled the activity of the persecutors. The Covenanters were driven to resistance, and a body of them defeated Claverhouse at Drumclog on 1st June. The Duke of Monmouth was, in consequence, called to the command of the army, and defeated the insurgents at Bothwell Brig on 22d June. After this Claverhouse was sent into the west with absolute power, and exercised it in such a manner as to lead to the belief that in addition to the persecuting policy of his superiors he was actuated by personal revenge. In 1682 he was appointed sheriff of Wigtonshire. In the execution of this office he was assisted by his brother David. According to the popular accounts the two brothers pursued an unsparing career of robbery and murder, forcing the rich to redeem by ruinous fines suspicions of disloyalty, which were arbitrarily attached to them, and murdering in cold blood the poor who refused to swallow every pledge which a drunken dragoon might offer them. To an evil reputation like this there is no doubt that many unauthenticated popular legends of cruelty have attached themselves, but the very number and atrocity of such tales is proof of the horror which his deeds have inspired. The case of John Brown, whom he shot in 1685, before his wife and family, has become famous. The more terrible he made himself to the Covenanters the more acceptable his career was to the government. He had, before the incident referred to, been made a privy-councillor, and received the estate of Dudhope, with other honours from the king. On the accession of James his name was at first withdrawn from the privy-council for family reasons, but was soon restored. In 1686 he was made brigadier-general, and afterwards major-general. In November, 1688, after William had landed, he received from James in London the titles of Lord Graham of Claverhouse and Viscount Dundee. When the king fled he returned to Edinburgh, but finding that city in possession of the Covenanters he retired to the north. He was followed, by order of the Convention, by General Mackay. Claverhouse was joined by some of the Highland chiefs occupying Perth, and made an attempt on Dundee, and finally encountered Mackay in the pass of Killiecrankie, whom he defeated 17th July, 1689, but was killed in the battle. Attempts have been made by Sir Walter Scott and others to throw a halo of sentimentality and heroism around his character; but it is clear that he was the willing instrument of a cruel government, and had himself little sentiment or softness in his nature. See Life by Mowbray Morris (1887).

GRAHAM, THOMAS, D.C.L., F.R.S., master of the mint, an eminent chemist, was born at Glasgow, 21st December, 1805. He received the rudiments of his education at Dr. Angus's English Academy and the high-school. After a five years' course at the latter he entered the University of Glasgow in 1819, and graduated M.A. in April, 1824. He had been educated with a view to the church, but a taste for the natural sciences developed during his university career, and he selected chemistry as his special pursuit. He went to reside in Edinburgh, where he continued his studies. His first publication was a paper in the Scots Mechanics' Magazine, On the Absorption of Gases by Liquids. Several other scientific papers were written by him in 1826. In 1827 he commenced teaching private mathematical classes in Glasgow, and published a paper on Longchamp's Theory of Nitrification, and presented another to the Royal Society of Edinburgh, published in their Transactions for 1831, on a class of bodies formed by dissolving certain deliquescent salts in alcohol and crystallizing them. These bodies, which he called alcoates, contain alcohol instead of water of crystallization. In 1828 he communicated to the Royal Society of Edinburgh the results of experi-

ments on the absorption of vapours by liquids. He was elected a member of the society the same year. During the winter session of 1828–29 he conducted the business of a laboratory in connection with Portland Street Medical School, and attended the classes of anatomy and chemistry in the university. In 1829 he succeeded to the lectureship of chemistry in the Mechanics' Institution. He also attended the medical classes in the university, and repeated the chemical course. He published papers during this year in the Quarterly Journal of Science on the Oxidation of Phosphorus and the Diffusion of Gases. In 1830 he was appointed professor of chemistry in the Andersonian University. In 1831 he laid before the Royal Society of Edinburgh the result of a series of experiments on ten different gases, from which he arrived at the conclusion that gases tend to diffuse inversely as the square root of their specific gravities, a conclusion which has been received as the law of the diffusion of gases. In May, 1833, he received the Keith medal for this paper, which was published in the Transactions of the society for 1834. In 1833 his first paper to the Royal Society of London was read and included in the Philosophical Transactions of the society for the year. It contained an investigation into the constitution of the arseniates and phosphates. In 1834 he became a member, and was elected vice-president of the Glasgow Philosophical Society. The same year he contributed in an important paper to the British Association meeting at Edinburgh the result of investigations on the function of water in different kinds of salts. This investigation he applied to the constitution of phosphoretted hydrogen, a paper on which was read to the Royal Society of Edinburgh in 1836. In 1835 he was chosen one of the committee of the chemical section of the British Association, and a corresponding member of the Berlin Academy, and in 1836 a Fellow of the Royal Society. In 1837 he was elected professor of chemistry in the University of London, and soon after settling in the metropolis he was appointed assayer to the mint. In 1840 he received the gold medal of the Royal Society. In 1841 he was chosen first president of the Chemical Society, which he had assisted in founding. In 1842 his father died and left him considerable property, a large part of which he resigned to his brothers and sisters, as his professional income was so ample or his pecuniary ambition so small as to render this accession to his means superfluous. This year he published his Elements of Chemistry. He now began to be employed as a consulting chemist in various mercantile and public undertakings, but the pecuniary gains of this career did not tempt him from his more valuable original investigations, and he appears to have given his services only in a few special cases. It was by his recommendation that wood-spirit or methylic alcohol was used to render spirits sold free of duty for trade or scientific purposes unfit for consumption as a beverage. He was also consulted, along with other eminent chemists, about the London water supply. Allsopp and Sons, the celebrated brewers of Burton-on-Trent, desiring to meet by a scientific investigation a wide-spread rumour that strychnine was freely used for the fraudulent adulteration of bitter ale, applied to him to lend the weight of his authority for that purpose. Being reluctant to enter upon this investigation, he asked a fee which he thought would cause the application to be withdrawn. He had, however, miscalculated the resources of a great mercantile interest. He received a cheque for double the amount he asked, and was compelled to undertake the inquiry. It resulted in showing, among other things, that the amount of strychnine required to adulterate the pale ale made annually at Burton would amount to sixteen times the quantity manufactured in the same period throughout the world, at the same time tests sufficient to detect the 1000th part of a grain of strychnine were applied, but none was found. In 1846 he assisted in founding the Cavendish Society, of which he was elected president, an office he retained till the close of his life. He edited some of the early reports, and occupied much of his time with the work of the society. At the same time he was engaged in investigations on the diffusion of liquids, to which he devoted the Bakerian lecture read by him in 1849, and contained in the Philosophical Transactions for 1850. This year he again received the gold medal of the Royal Society. He again read the Bakerian lecture in 1854. The subject he chose was Osmose, a term used to designate the mutual diffusion of liquids through a porous septum, which he applied to illustrate the theory of the flow of sap in plants, already discussed by Dutrochet. In 1855 he was made master of the Mint. In 1860 he was again chosen vice-president of the Royal Society. In 1861 he described to the Royal Society the continuation of his experiments on liquid diffusion. He distinguished in liquid solutions two kinds of substances, the one diffusive, the other non-diffusive, to which he gave the names of crystalloids and colloids. He found that colloids were pervious to crystalloids, but not to other colloids. Thus when a mixed solution of sugar (crystalloid) and gum (colloid) is placed on a sheet of unsized paper, stretched on a hoop and floated in water, the greater part of the liquid sugar penetrates the septum within twenty-four hours, while all the gum is retained. To this process of separation he gave the name of *dialysis*, and called the instrument by which it was effected a dialyzer. (See DIALYSIS.) Simultaneously with this paper he published another upon liquid transpiration, or the diffuson of liquids through capillary tubes. For these papers he received the Copley medal in 1862. In a subsequent paper, Philosophical Transactions, 1866, he applied these discoveries to gases, the separation of which by diffusion he called *atmolysis*. The passage of gases through heated metal plates formed another subject of curious and interesting investigation. Among other results of this investigation, following the labours of Deville and Troost, he found that pure iron takes up, at a low red heat, and retains when cold, 4·15 times its volume of carbonic oxide gas. This property he called the *occlusion* of gases. He found it exist in platinum to the extent of 3 to 5, and in palladium to the extent of 500 to 600 volumes of hydrogen. From the investigation of a piece of the meteoric iron of Lenarto he concluded that it must have passed through a dense hydrogen atmosphere, as the gas occluded in it was three times the amount with which malleable iron can be impregnated in our atmosphere. His final conclusion was that hydrogen was the vapour of a highly volatile magnetic metal, to which he gave the name of hydrogenium, and ultimately assigned the specific gravity of 0·733. The paper in which this conclusion is maintained was read to the Royal Society on 15th January, 1869. He had previously announced it to Dr. Hofmann in acknowledging his election in 1868 as a member of the German Chemical Society of Berlin. He added a postscript to the paper on 17th June. He died from inflammation of one of his lungs, the result of a chill, on 16th September, 1869. His works have been collected and printed by Dr. James Young and Dr. Angus Smith. A bronze statue of Graham was presented to the city of Glasgow by Dr. Young in 1872.

GRAHAME, JAMES, author of The Sabbath, The Birds of Scotland, and other poems, was born in

Glasgow on the 22d April, 1765. After passing through a regular academical course of education at the university of his native city, he was removed to Edinburgh for the purpose of studying law, and in 1791 he was admitted a member of the society of Writers to the Signet. As his father stood at the head of the legal profession in Glasgow, his prospects of success in business were considerable; but from early life he entertained a dislike to the law, and aspired to the distinction of becoming a clergyman. He, however, did not give way to his desire for many years; for in 1795 we find him admitted to the Faculty of Advocates, of which learned body he continued a member until 1809, when he entered holy orders as a clergyman of the Church of England. Previous to this all his literary productions had been published. While at the university he printed and circulated a collection of poetical pieces. These appeared in an amended form in 1797. In 1801 he published a dramatic poem entitled, Mary, Queen of Scotland, and in 1802 appeared, anonymously, The Sabbath. The Birds of Scotland, and British Georgics followed. After his ordination he obtained the curacy of Shipton Moyne, in Gloucester, which he held for half a year, when he was recalled to Scotland by family affairs. While in Scotland he was an unsuccessful candidate for St. George's Episcopal Chapel, Edinburgh. In August, 1810, he was appointed interim curate to the chapelry of St. Margaret, Durham, where his eloquence as a preacher quickly collected a large congregation, and after having officiated there for a few months he obtained the curacy of Sedgefield, in the same diocese. The clerical profession did not afford him that measure of happiness which he had anticipated. His health failed him, and he was advised to seek his native air. He, therefore, proceeded with his wife to Glasgow, but had only arrived there two days when he expired, at the residence of his eldest brother, Robert Grahame of Whitehill, on the 14th of September, 1811, leaving two sons and a daughter. Mr. Grahame's poetry is chiefly of a meditative and religious cast, but animated, flowery, and descriptive. His character was marked by great gentleness of disposition and simplicity, and his personal appearance was strikingly handsome. He inherited from his family strong Whig principles, which he entertained to the last.

GRAHAM ISLAND, or FERDINANDEA, an island which in 1831 rose up in the Mediterranean, about 30 miles south-west of Sciacca, in Sicily, at a spot where, a few years before, a depth of more than 100 fathoms had been found. On 18th July it was 12 feet above water, and had a crater emitting lava and columns of vapour, and on 4th August it attained its maximum height of 200 feet, with a circuit of 3 miles. It soon afterwards began to lower, and finally disappeared, leaving quite deep water.

GRAHAM LAND, a tract of land in the Antarctic Ocean; discovered in 1832 by Biscoe, between lat. 63° and 68° S., and lon. 61° and 68° W.

GRAHAMSTOWN, a town of Cape Colony, district of Albany, 106 miles by rail north-east of Port Elizabeth. It is well built, has an Anglican and a Roman Catholic cathedral, town-hall (with museum), post-office, St. Andrew's and other colleges, several higher schools, the Albany Hospital, lunatic asylum, court-house, Albany Hall, bacteriological institute, botanic gardens, barracks, &c. Pop. (1891), 10,498; (1904), 13,877.

GRAIL. See GRAAL.

GRAIN, the name of a small weight, the twentieth part of a scruple in apothecaries' weight, and the twenty-fourth of a pennyweight troy.

GRAIN, corn, any cereal cultivated on account of its seed for the production of meal or flour. All kinds of grain contain nutritious particles of a similar character, although they vary, both in their quantity and in their mixture, in various grains. These elements are—1, gluten, which affords the strongest nourishment for the animal body; 2, fecula or starch, which is very nutritious, although not so much so as gluten, which, however, it seems to render more digestible; 3, a sweet mucilage, which is more nutritious than starch, but is small in quantity, and renders the grain liable to the vinous and acetous fermentation; 4, a digestible, aromatic substance contained in the hulls, which consist of a fibrous matter; 5, moisture, which is predominant even in the driest grain, and increases the weight of the mass, although it lessens the specific gravity; it affords no nourishment, hastens the decomposition of all kinds of grain, if they are not kept very dry, and serves, after planting, to stimulate the first motions of the germ.

GRAINING (*Leuciscus Lancastriensis*), a fish which in Great Britain is found chiefly, if not exclusively, in the Mersey and its tributaries, and occurs also in some of the Swiss lakes. It has a strong resemblance to the dace, but the nose is more rounded, the eye rather larger; the dorsal fin commences exactly half-way between the point of the nose and the end of the fleshy portion of the tail, whereas in the dace it arises behind the middle; and all the fins are a little longer than in the dace. As described by Yarrell, it has the top of the head, the back, and the upper part of the sides pale drab colour, tinged with bluish red, separated from the inferior and lighter parts by a well-marked line; irides yellowish white; cheeks and gill-covers shining silvery white, tinged with yellow; fins pale yellowish white. It is seldom more than half a pound in weight. Its habits and food resemble those of the trout, and it is fished for with the fly or the worm.

GRAKLE (*Gracula*), a genus of birds belonging to the order Passeres, and to the family of the Starlings (Sturnidæ), inhabiting India and New Guinea. The Indian mino or mina bird (*G. musica*) is one of the best known, as it is often kept in a state of domestication. It is very intelligent and affectionate, can be taught many amusing tricks, and can imitate the human voice as well as any of the parrots. Its colour is a deep velvet black, with a white mark on the base of the quills of the wing, the bill and feet are yellow, and there are two yellow wattles on the back of the head. The crowned grakle (*G. coronata*) is another species. It receives its name from having the top of the head and part of the nape (as well as the chin and part of the primary quills) bright yellow. The general colour of the bird is deep green, shot with blue and sooty black. A considerable number of other birds not belonging to this genus have also been called grakles, such as the purple grakle, or crow-blackbird of America. See CROW-BLACKBIRD.

GRALLATORES, an order of birds which formerly included the heron, ibis, stork, but these are now separated as Ciconiæ, and the Grallatores, properly so called, consist of the families to which the snipe, stint, and ruff belong, *Scolopacinæ;* the *Totaninæ*, the red shanks, green-shanks, and sand-pipers; *Numeniæ*, the curlews and whimbrels, the phalaropes, stilts, and avocets; *Charadriidæ*, the plovers, oyster-catchers, turnstones, lapwings, coursers; *Parridæ*, the jacanas of America and Asia; *Otidæ*, the bustards; *Rallidæ*, the rails and coots; *Gruidæ*, the cranes.

GRAMMAR is popularly defined as the art of speaking and writing a language correctly. This definition applies to grammar only in its relation to particular languages. In its most comprehensive sense grammar may be divided into general, comparative, and particular. Particular grammar con-

sists of the body of laws and customs by which a particular language is regulated; comparative grammar of the laws, customs, and forms which are shown by comparison to be common to various languages; general grammar of those laws which, by logical deduction, are demonstrated to be common to all. Comparative grammar is also called comparative philology; general grammar is called reasoned or philosophical grammar.

The divisions of grammar vary with the class and also with the method of treatment. In common English grammars the division effected is generally fourfold. The divisions are: *orthography*, which treats of the proper spelling of words, and includes orthoepy, treating of the proper pronunciation; *etymology*, which treats of their derivations and inflections; *syntax*, of the laws and forms of construction common to compositions in prose and verse; *prosody*, of the laws peculiar to verse.

GRAMMAR-SCHOOLS is an ancient name given to a class of schools at which a secondary education is given, as a preparation or substitute for a university course. In England a distinction, not very well defined, is made between public schools (such as Eton, Harrow, Winchester, &c.) and grammar-schools, the former seeming to be merely the more important and prominent schools of the class to which both belong. The term grammar-school seems to be derived from the fact of the almost exclusive occupation of these schools, until comparatively recent times, having been the teaching of the elements or grammar of the Latin and Greek languages. The character of the teaching in secondary schools, where it is not restricted by endowments, is necessarily a good deal influenced by the course of instruction in the universities, in which the classical element still preponderates. This influence appears to be stronger in the public or grammar schools of England than in Scotland. In the latter country the grammar-schools appear rather to have led than followed the movement, which is still progressing, of adapting the higher education to the practical requirements of modern life, and to have made preparation for the university only a subordinate or incidental end of the training they afford. Among the grammar-schools of England are a large number of endowed schools, the teaching in which is restricted by the terms of their foundation. The Act 3 and 4 Vict. cap. lxxvii. was passed to relieve such schools from restrictions which have become obsolete. It recites that there are many endowed schools in England and Wales, both of royal and private foundation, for education wholly or principally in grammar, that the term grammar has been construed by the courts of equity as having reference only to the dead languages Greek and Latin, and that such education has become of little value without instruction in other branches of literature and science, so that the intentions of the founders of such schools are liable to be frustrated, and gives power to the court in cases of equity to extend the system of education in such schools, with due regard to the intention of the founders, and even when deemed indispensably necessary, from deficiency of funds, to dispense with the teaching of Greek and Latin altogether.

GRAMME, the unit of weight in France = 15·4323 grains. A decagramme or ten grammes = 5·644 drams; a hectogramme (100 grammes) = 3·527 oz.; a kilogramme (1000 grammes) = 2·205 lbs.; a myriagramme (10,000 grammes) = 22·046 lbs. See DECIMAL SYSTEM.

GRAMMONT, a town of Belgium, East Flanders, 22 miles S.S.E. of Ghent, on both sides of the Dender. It consists of a high and a low town, and has two churches, a town-house, gymnasium and other schools, orphan and ordinary hospitals; manufactures of linen, lace, thread, tobacco-pipes, &c.; and soap-works, tanneries, bleacheries, breweries, distilleries, a foundry, and a paper mill. Pop. (1900), 11,997.

GRAMONT, or GRAMMONT, PHILIBERT, COUNT OF, son of Anthony, duke of Grammont, was born in 1621. He served under the Prince of Conde and Turenne, but, having rashly paid his addresses to a lady who was a well-known favourite of Louis XIV., he was obliged to quit France, and went to England two years after the Restoration. He was highly distinguished by Charles II., possessing, with a great turn for gallantry, much wit, humour, politeness, and good nature. He seems to have been indebted for his support chiefly to his profits at play, at which he was very successful. He married Miss Elizabeth Hamilton, daughter of Sir George Hamilton, and died in 1707. His celebrated Memoirs were written by his brother-in-law, Anthony, generally called Count Hamilton, who followed the fortunes of James II., and afterwards entered the French service, and died in 1720.

GRAMPIAN MOUNTAINS, a well-known range of mountains, Scotland, stretching across the country diagonally S.W. to N.E. for a distance of about 150 miles. Its limits are not well defined, but it may be said to commence near the south-west end of Loch Awe, on the west coast of Argyleshire, whence the main ridge runs, in a well-marked course, along the northern boundaries of Perthshire to Cairn Ealer, where it separates into two distinct branches—one stretching N.N.E. on the north side of the Dee, and terminating near Huntly; the other running nearly due east on the south side of that river, and terminating in the neighbourhood of Stonehaven. The offsets of the Grampians are diffused over a wide extent of country, both north and south of the principal ranges; extending on the latter to Stirlingshire and Dumbartonshire, and including a large portion of the surface of Perthshire. With exception of Ben Nevis, the Grampians comprise all the highest mountains in Scotland. Amongst these are Ben Cruachan, 3689 feet; Ben Lomond, 3192 feet; Ben Lawers, 3984 feet; Schiehallion, 3547 feet; Ben Macdhui, 4296 feet; Cairngorm, 4084 feet; Cairntoul, 4241 feet; &c. The more remarkable passes are those of Leny, Aberfoyle, Glenshee, and Killiecrankie.

GRAMPUS (*Phocæna Orca*), an animal of the cetacean order, closely allied to the porpoise, to which genus it is often referred. It is one of the largest of the dolphin family, attaining 20 to 25 feet in length and 4 feet in diameter at its greatest thickness. It tapers both to the head and tail, being much more elongated towards the latter. The head is round, the muzzle truncated, the upper jaw projecting slightly over the lower. Its teeth are large, conical, slightly curved behind, eleven on each side of the upper and under jaw. Its dorsal fin is 4 feet in height, is curved behind, and terminated in a point. The pectoral fins are broad at the base and rounded at the extremities. The body is of a brilliant black colour above and pure white below. An irregular black patch extends from the sides of the tail towards the flanks. There is a white patch above the eye. It is very voracious, preying on small cetaceans, &c., and it even attacks whales in troops. It also preys on salmon, and pursues them up the mouths of rivers.

GRAN, a town in Hungary, capital of the county of the same name, on the right bank of the Danube, above the mouth of the Gran, 25 miles N.W. of Budapest. It consists of the town proper and several suburbs, and is so ancient as to possess considerable historical interest. Its origin is attributed to the Romans, in after-times it became the residence of

the Hungarian monarchs, and it was held by the Turks from 1543 till 1683. It is the see of an archbishop, the primate of Hungary, and its cathedral, built in 1821–56 after the style of St. Peters at Rome, finely situated on a lofty precipitous rock, is the most splendid ecclesiastical structure in the kingdom. There are hot mineral springs here. Pop. (1890), 15,749; (1900), 17,909.

GRANADA, a province of Spain, forming one of the three provinces, Granada, Almeria, and Malaga, into which the ancient Moorish kingdom of Granada has been divided; and bounded north by the provinces of Jaen and Albacete, east by Almeria, south by the Mediterranean, and west by Malaga and Cordova; area, 4937 square miles. The coast, which has a length of 66 miles, is for the most part rocky and dangerous, from the shoals which line it; but has several small bays in which vessels find tolerable shelter. The interior is generally mountainous, being traversed chiefly from east to west by several ranges, particularly the Sierra Nevada, whose culminating point, Mulhacen, is 11,781 feet high, and is the loftiest summit in Spain. The mountains are generally composed of micaceous schist, which passes into gneiss and argillaceous schist; above these, on the south slope, occur black calcareous rocks, often rich in lead ore. Between the mountain ranges are numerous valleys, many of them distinguished by their beauty and fertility. The province is divided by the mountains into two principal basins, the one of which carries its waters north to the Guadalquivir, and the other south directly to the Mediterranean. The principal streams are the Genil, Darro, and Guadalfeo. From the rocky nature of the surface the extent of arable land is limited, and on many spots the soil has no great depth; but industry has done much for its improvement; and many spots, apparently of little natural fertility, present the appearance of large gardens. The principal crops are wheat and barley; next are those of maize, beans, haricots, hemp, and flax. Both the olive and the vine are extensively cultivated, and fruit in great variety and of excellent quality is very abundant. The sugar-cane thrives well in some parts, particularly at Almuñecar on the coast. Neither manufactures nor trade are of much consequence. Granada is the capital. Pop. (1900), 492,460.

GRANADA, a celebrated city in the south of Spain, and capital of the above province. The situation is highly romantic, at the foot of the Sierra Nevada and on the rivers Darro and Genil. The town exhibits to the approaching traveller the form of a half-moon, its streets rising above each other, with a number of turrets and gilded cupolas, the whole crowned by the Alhambra, or palace of the ancient Moorish kings, and in the background the Sierra de Nevada, covered with snow. But on entering the gates all this grandeur disappears; the streets are found to be narrow and irregular; the buildings display visible marks of decay, and are inferior to those of many other towns in Spain. Granada is built chiefly on two adjacent hills, and divided into four quarters. The river Darro flows between the two hills, and traverses the town, after which it falls into the larger stream of the Genil, which flows outside the walls. In point of extent Granada is nearly as great as in the days of its prosperity. The cathedral is an irregular but splendid building; the archbishop's palace is also extensive and elegant, likewise the mansion occupied by the captain-general of the province. But the grand ornament of Granada is the Alhambra. Though now, like the town, in a state of decay, its remains sufficiently show its original splendour. (See ALHAMBRA.) It commands a beautiful prospect; but a still finer is afforded by another Moorish palace, called the *Generalife*, built on an opposite hill, once the retreat of the court during the heat of summer. Granada has various manufactures, such as silk and woollen stuffs, leather, paper, hats, &c. It is the seat of a university, founded about 1530, and has a normal school and other educational institutions. Granada was founded by the Moors before 800, near the site of the ancient Illiberis, and from 1036 to 1234 was included in the Kingdom of Cordova. In 1235 it became the capital of a new kingdom, and attained to almost matchless splendour. Its population at this period has been estimated as high as 700,000. In 1491 it remained the last stronghold of the Moors in Spain, and mustered 60,000 men to defend itself against Ferdinand and Isabella, who had now arrayed the flower and strength of their united kingdoms, and encamped before it. The defence proved unavailing, and the besiegers took possession of it in 1492. Next year it was made the seat of an archbishopric. The great body of its inhabitants still were Moors, and its prosperity continued almost without diminution for another century till 1610, when the decree expelling the Moors from all parts of Spain was nowhere more severely felt than in Granada, which immediately sunk, and has never recovered. Pop. (1900), 75,900.

GRANADILLA, or GRENADILLA (Spanish), a name given to various tropical species of the passion-flower. Passion-flowers are a numerous race, chiefly natives of the West Indies. Some species have been introduced into Great Britain for the beauty of their flowers, but few bear fruit. The granadillas most commonly met with in that country are those of the West India Islands, the chief of which are the purple-fruited *Passiflora edulis*, the *Passiflora quadrangularis*, and the water-lemon, *Passiflora laurifolia*. The fruit of the first is green when unripe, but ripens to a dark livid purple, and much resembles the fruit of the purple egg-plant. It is elliptic in shape, 1½ inch in diameter, and 2 inches from the stalk to the top. The pulp is orange-coloured, and contains numerous seeds. The taste is acid, and somewhat like that of an orange. It is a native of the Brazils, was introduced into Britain in 1810, and produces fruit abundantly in the stoves at the royal gardens, Windsor, and other places. The flesh-coloured granadilla (*Passiflora incarnata*) has a fruit when ripe of about the size of an apple, orange-coloured, with a sweetish yellow pulp. It is a native of Virginia. The *Passiflora quadrangularis* is the most valuable for cultivation in Great Britain. It has borne fruit in the gardens of the Horticultural Society of London. The fruit of the water-lemon has a watery but agreeable juice, with a lemon flavour, whence the name.

GRAN CHACO, EL, a territory of the Argentine Republic, bounded north and east by Bolivia, east by Paraguay, south and west by Santiago del Estero, and west by Tucuman and Salta. It is about 400 miles long, and 200 to 250 broad. Area, about 52,740 square miles. It is watered by the Vermejo and Pilcomayo and numerous other affluents of the Paraguay. In the west it is intersected by offsets of the Andes, and in the east forms extensive plains and marshes, with tracts at times entirely inundated, while in the south are vast sandy deserts, interspersed with salt pools. It is thinly inhabited by Indians, who live chiefly by hunting and fishing. In some parts the forests are extensive, and the vegetation rich. Pop. (1895), 10,422.

GRAND COUSTUMIER, a term applied to a collection of the ancient laws or customs of the Duchy of Normandy, which were in use in England during the reigns of the early Norman sovereigns,

and which still form the basis of the laws of the Channel Isles, which formerly belonged to that duchy. The Grand Coustumier is supposed to have been compiled subsequently to the reign of Richard I. From the great resemblance between the Norman customs and the common law of England it seems probable that the latter is considerably indebted to the former, although Sir Matthew Hale contends that the similarity arises from English customs having been introduced into Normandy.

GRANDEE (Spanish *Grande*, pl. *Grandes*). In the Kingdom of Castile, and in that of Arragon, there was a distinction of rank among the nobles of the country, who belonged partly to the higher and partly to the lower nobility. The *ricos hombres* (literally rich men) made up the former; the knights (*cavalleros*) and gentlemen (*hidalgos*) the latter. The circumstances of the establishment of the new Christian states, which were founded and enlarged amid perpetual struggles against the Moors, procured an important share in the public affairs for the descendants of the men who constituted the first armed associations for the deliverance of their country. These were the higher nobility. They limited the power of the king; they surrounded him, as his councillors, by birthright, and had a priority of claim to the highest offices of state. As early as the thirteenth century these rights were legally recognized as belonging to certain noble families, and even the name *grandee* occurs about that age in the code of laws which Alfonzo X. established in the Kingdom of Castile. This distinction belonged only to the principal members of the higher nobility, as many were reckoned in this class who were not called grandees. But none were called grandees who were not *ricos hombres*, that is, descended from a family of the ancient nobility. The grandees consisted partly of the relatives of the royal house, and partly of such members of the high feudal nobility distinguished for their wealth as had by the grant of a banner received from the king the right to enlist soldiers under their own colours, and had thus acquired precedence of the other *ricos hombres*, which distinction regularly descended to their posterity. As *ricos hombres* they partook of all the privileges of the high nobility; as such they possessed certain feudal tenures (called *royal fiefs* or *lordships*) in consideration of which they were bound to serve the king with a proportionate number of lances (each of which consisted of a horseman with four or five armed attendants); these fiefs they could be deprived of only in certain cases determined by law. They were free from taxes on account of serving the king with their property and persons in war. They could not be subjected to the jurisdiction of any civil or criminal judges without the special commission of the king. They might at any time, during the anarchy of the middle ages, leave the kingdom, together with their vassals, without hindrance, and withdraw themselves from the laws and feudal service of their country, and join another prince, even against their former sovereign, without being considered traitors on that account. Besides these general prerogatives of the higher nobility, and the priority of claim to the highest offices of state, the grandees possessed some peculiar distinctions. Such in particular was the right of covering the head in the presence of the king, with his permission, on all public occasions—an ancient privilege among the Spaniards, which had its origin in the spirit of a limited feudal monarchy; this, however was conceded also to the (so called) *titulos* (titled personages, viz. dukes and counts). The king called each of them 'my cousin' (*mi primo*), while he addressed the other members of the high nobility only as 'my kinsman' (*mi pariente*). In the cortes they sat immediately after the prelates, before the *titulos*. They had free entrance into the palace and apartments of the king, and on festival occasions sat in the royal chapel near the altar. Their wives participated in the external marks of respect belonging to the rank of their husbands; the queen rose up from her seat to receive them, and cushions were laid for them upon an elevated settee (*estrada*). After Ferdinand and Isabella, guided and assisted by the able Ximenes, crushed the power of the feudal nobility, the privileges of the higher nobility were diminished, and at the close of the fifteenth century the name of the *ricos hombres* was lost, together with their privileges. Though Ferdinand's successor, Charles V., was little inclined to give up the struggle for unlimited power, he nevertheless found many inducements to attach some of the principal men of the kingdom to himself, and to reward others for the important services which they had rendered him in the suppression of the insurrection of the commons. The rank which ancient custom had fixed in the respect of the people he distinguished by the name of *grandezza*, and raised to be a particular order of nobility, the prerogatives of which consisted mostly in external marks of distinction. Thus he avoided reviving the power possessed by the feudal nobility in early ages, and completed what had been begun under Ferdinand and Isabella by making of an independent feudal nobility a dependent order of court nobles. There were three classes of grandees. Some the king commanded to be covered before they spoke to him: these were grandees of the first class. Others received the command as soon as they had spoken, and so heard his answer with their heads covered: these were grandees of the second class. Others again did not receive the king's command to be covered until after he had answered them: these were grandees of the third class. Latterly, it is true, these distinctions of rank became antiquated; but there were still three classes of grandees, although without any essential differences. They all enjoyed, besides the abovementioned privileges, that of being called *excellency*, and that of having a stamp given with the foot when they entered the royal palace through the hall of the guards by way of notice to the sentinel to present arms to them. They had no other marks of distinction from the rest of the high nobility. They did not constitute a particular society, as did formerly the dukes and peers in France; and no high offices were exclusively appropriated to them unless perhaps the mastership of the horse, the lord-chamberlainship, and the captaincy of the halberdier guard, be so considered. In truth the royal will was not subjected to any limits in the nomination even to these court offices.

GRAND JURY. See JURY.

GRAND PENSIONARY, an officer of the Republic of the United Provinces, or rather of the Province of Holland. In the great towns of this republic the first magistrate was called a pensionary, from the fact of his office being a paid one. The grand pensionary was the secretary of state of the Province of Holland. His functions were to propose to the states of the province the measures on which they had to deliberate, draw up the minutes of the deliberations, or the decrees of the assembly, to treat with foreign ambassadors, to superintend the administration of the finances, &c. He was a member of the executive government, and represented his province in the states-general, in which his position gave him great influence. He held office for five years, and was eligible for re-election Among the most distinguished holders of the office were Jan de Witt and Heinsius. It was held by Schimmelpenninck in the Batavian Republic formed under French influence in 1795, and abolished on the formation of the Kingdom of Holland in 1806.

GRAND PRIX. See ÉCOLE DES BEAUX ARTS.

GRAND RAPIDS, a city of the United States, capital of Kent county, Michigan, situated on the rapids of the Grand River, 40 miles from its mouth in Lake Michigan. It is handsomely built, and has a pleasant and healthy situation. Steamers run daily to Grand Haven at the mouth of the river. There are numerous manufactories, in which the machinery is partly driven by water-power derived from the rapids. Near the city there are large and valuable gypsum quarries. There is also a large trade in pine and hardwood lumber. The Michigan Soldiers' Home, and many other charitable institutions are situated in the city. Grand Rapids was incorporated in 1850, when it had a population of 2669. Pop. in 1870, 16,507; in 1890, 60,278. The city limits were extended in 1891, and the population in 1900 was 87,565.

GRAND SERGEANTY, an ancient tenure of land similar to knight-service, but held to be of superior dignity. Instead of serving the king generally in his wars, the holder by this tenure was bound to do him some specified honorary service, to carry his sword or banner, to be the marshal of his host, his high-steward, butler, champion, or other officer. Grand sergeanty, in regard to the services imposed by it, was abolished along with other military tenures by statute 12 Charles II. cap. xxiv., by which it was decreed that all such tenures should be converted into free and common socage.

GRANGEMOUTH, a seaport and police burgh, Stirlingshire, Scotland, at the entrance of the Forth and Clyde Canal, 3 miles E.N.E. of Falkirk. Among the chief buildings are the parish and other churches, free library, public hall, town-hall, public institute, &c.; and there is a public park presented by the Earl of Zetland. The town was founded in 1777 in connection with the construction of the canal; its prosperity was increased by the opening of the first dock in 1843, and its importance was considerably augmented by the completion of new docks and a timber basin in 1882. Other new docks with a deep-water entrance are in course of construction. The industrial establishments include an iron-foundry, ship-building yards, and rope and sail making works. The imports consist of timber, pig-iron, flax, grain, fruit, chemicals, &c., and among the exports are coal and iron. Pop. in 1891, 6354; in 1901, 8386.

GRANITE, an unstratified crystalline rock often considered as the foundation rock of the globe, or that upon which all secondary rocks repose; but whatever may be its antiquity in most cases, it has been found occurring in the chalk system at the close of the secondary epoch; and it is ascertained that any rocks containing the proper ingredients, no matter of what geological age, may be altered into gneiss, or mica-schist, or clay-slate, while granite may be intruded into rocks of any age. From its great relative depth it is not often met with except in Alpine situations, where it presents the appearance of having broken through the more superficial strata of the earth, the beds of other rocks in the vicinity rising towards it at increasing angles of elevation as they approach it. It is composed of three minerals, namely quartz, felspar, and mica, which are more or less perfectly crystallized and closely united together. They vary considerably in the relative proportions in which they exist in the granites of different localities, as also in the size of the grains; but felspar is usually the predominating ingredient. Granite has been divided into several sub-species or varieties. Of these the following are the most important:—*Common granite*, in which the three ordinary constituents above mentioned occur in nearly equal proportions; the felspar may be white, red, or gray. *Porphyritic granite*, in which large crystals of felspar are disseminated through a common granite, whose ingredients are fine-grained. *Graphic granite*, which consists of felspar in broad laminæ, penetrated perpendicularly with long, imperfect crystals of quartz, whose transverse angular sections bear some resemblance to certain letters, especially to those of oriental languages. *Syenite* or *syenitic granite*, in which hornblende, either wholly or in part, supplies the place of mica. *Talcose* or *chloritic granite* (the *protogine* of the French), in which talc or chlorite takes the place of the mica. *Felspathic granite* (the *white-stone* of Werner and the *eurite* of the French), in which felspar is the principal ingredient.

Granite occurs in masses of vast thickness, which are commonly divided by fissures into blocks that approach to rhomboidal or tolerably regular polyhedral forms. In some instances, however, it affects a laminated structure, owing to the preponderance of mica and its arrangement in layers. When this is the case it passes into the rock called *gneiss* (which see). The aspect of granitic mountains is extremely diverse, depending in part upon the nature of its stratification and the degree of disintegration it has undergone. Where the beds are nearly horizontal, or where the granite, from the preponderance of felspar, is soft and disintegrating, the summits are rounded and heavy. Where hard and soft granite are intermixed in the same mountain the softer granite is disintegrated, and falls away, leaving the harder blocks and masses piled in confusion upon each other like an immense mass of ruins. Where it is hard, and the beds are nearly vertical, it forms lofty pyramidal peaks or *aiguilles*, like the Aiguille du Dru and others in the neighbourhood of Mont Blanc.

Granite forms some of the most lofty of the mountain chains of the eastern continent. In Europe the central part of the principal mountain ranges is of this rock, as in Scandinavia, the Alps, the Pyrenees, and the Carpathian Mountains. In Asia granite forms a considerable part of the Uralian and Altaic ranges of mountains; and it appears also to compose the principal mountains that have been examined in Africa. It is very abundantly distributed over the northern parts of the American continent, as in Labrador, Eastern Canada, and the New England states. In New Hampshire it is the predominating rock of the White Mountains, in which it attains the elevation of more than 6000 feet. In the Andes it has been observed at the height of 11,000 feet, but it is here generally covered by an immense mass of matter ejected by ancient and recent eruptions.

Granite very frequently forms veins, shooting up into the superincumbent rocks, which seem to indicate that it has existed below in a state of fusion, the heat of which has softened and parted the upper rocks, and forced up the granite, in a melted state, into these fissures. Instances of this kind are very frequent in Scotland, where the strata of mica-slate and of gneiss are parted by dikes or veins of granite.

Granite abounds in crystallized earthy minerals; and these occur for the most part in those masses of it existing in veins. Of these minerals beryl, garnet, and tourmaline are the most abundant. It is not rich in metallic ores, though it contains mines of tin, as well as small quantities of copper, iron, tungsten, bismuth, silver, columbium, and molybdenum.

Granite supplies durable materials for architecture and for decoration. It varies much in hardness as well as in colour; accordingly there is room for much care and taste in its selection. The *oriental basalt*, found in rolled masses in the deserts of Egypt, and

of which the Egyptians made their statues is a true granite, its black colour being caused by the presence of hornblende and the black shade of the mica. The original statue of the Nile, which was placed in the Temple of Peace at Rome, was made from this granite. The *oriental red granite*, which is chiefly found in Egypt, is composed of large grains or imperfectly formed crystals of flesh-coloured felspar, of transparent quartz, and of black hornblende. Like the oriental basalt it is susceptible of a fine polish. Of the remarkable monuments of antiquity constructed of this beautiful granite Pompey's Pillar and the two famous obelisks (one in London) called *Cleopatra's Needles*, are the most celebrated. The former of these is 88 feet in height and 9 feet in diameter at its base; it is formed of but three pieces. The granites of the north and south of Scotland and the Island of Mull are extensively used in architecture and for sepulchral and other monuments.

GRAN SASSO D'ITALIA, or MONTE CORNO, a mountain of Naples, the culminating peak of the Apennines; lat. 42° 27′ N.; lon. 13° 38′ E.; height, 9519 feet.

GRANT, in law, a gift in writing of such a thing as cannot be passed or conveyed by word only, as a grant is the regular method by the common law of transferring the property of incorporeal hereditaments, or such things whereof no actual delivery of possession can be had. The operative words in grants are *dedi et concessi* (I have given and granted). Grants may be void by uncertainty, impossibility, being against law, or a mode to defraud creditors, &c.

GRANT, MRS., OF LAGGAN, a distinguished Scottish authoress, was born at Glasgow on 21st February, 1755. Her father, Duncan M'Vicar, was an officer in the British army, and her mother was descended from the ancient family of Stewart of Invernahyle in Argyleshire. Shortly after her birth her father proceeded with his regiment to America, but in 1768 he was compelled by ill health to return to his native country, and a few years afterwards was appointed barrack-master at Fort Augustus. Here his daughter made the acquaintance of the Rev. James Grant, the military chaplain, who became minister of Laggan, and to whom she was shortly afterwards married. Her husband died in 1801, and left her a widow with eight children, in very embarrassed circumstances. To provide for the wants of her household, a collection was made of a number of fugitive poetical pieces written by her at different times, which was published by subscription in 1802. A work of more lasting fame was produced by her in 1806, entitled Letters from the Mountains. Her other literary works include her Memoirs of an American Lady, and Essays on the Superstitions of the Highlanders of Scotland. In 1825 she obtained a pension from government of £50, afterwards increased to £100 per annum. She died at Edinburgh on 7th November, 1838. See her Memoirs and Correspondence (1844, 3 vols.).

GRANT, ULYSSES SIMPSON, a distinguished American general and president of the United States, born at Point Pleasant, Clermont county, Ohio, 27th April, 1822; died near Saratoga, 23d July, 1885. He studied in the military academy at West Point, and as lieutenant served with distinction in the Mexican War. He married in 1848; became captain in 1853; resigned his commission in the army in 1854, and afterwards engaged in farming. When the civil war broke out, Grant, then residing at Galena, was appointed colonel of an Illinois regiment, and soon became brigadier-general of volunteers. With the troops under his command he seized Paducah at the mouth of the Tennessee, and so secured the navigation of that river and of the Ohio. He then made a demonstration against Belmont on the Mississippi, destroyed the camp formed opposite Columbus, and cut his way back through the enemy's forces. His next movement (Feb. 1862), was against Fort Henry on the Tennessee river, which he captured, and then against Fort Donelson on the Cumberland river, which, after severe fighting, also surrendered. Grant was then ordered to concentrate his forces upon Corinth, where he was attacked by the Confederates near Shiloh, and after obstinate fighting succeeded in gaining a decisive victory, with the aid of opportune reinforcements. Subsequently he fought the battle of Iuka, fortified Corinth, repulsed an attack upon that town, and then turned his attention to the capture of the river fortress of Vicksburg. After months of unsuccessful effort Grant secured a landing thirty miles below the fortress (April, 1863); pushed forward towards Jackson, which he captured after the defeat of Johnston's army; turned promptly upon the forces under Pemberton, which were covering Vicksburg; routed them at Champion's Hill, and finally drove them back into the fortress, which he captured (July, 1863) after a regular siege. He was then appointed commander of the forces on the Mississippi, and in this capacity proceeded to the relief of the army of Thomas, shut up in Chattanooga. Here he utterly defeated the Confederates under Bragg, relieved the city, and opened the way for the northern forces into Georgia. This remarkable series of victories received national recognition in his appointment (March, 1864), as lieutenant-general and commander of all the northern forces. The plan he promptly adopted was to engage simultaneously all the Confederate armies, and so prevent them making any combined movement. He accordingly despatched Sherman into Georgia, Sigel into Virginia, directed Butler to capture Richmond, and with his own army of the Potomac he advanced from the Rapidan to the James river in a turning movement against Lee's forces. The battles which resulted—in the Wilderness, at Spottsylvania, North Anna, and Cold Harbour—were among the most bloody of the war. Lee fought stubbornly on the defensive; and it was only after a prolonged resistance that Petersburg and Richmond were taken, and the final defeat at Five Forks resulted in the surrender (April, 1865) of the southern army at Appomattox. The strategy of Grant had proved so completely successful that there was now no solid opposing force in the field. The war was over, and Grant's attention was now directed to disbanding the armies. While this was being effected the president, Abraham Lincoln, was assassinated; and in the political excitement which followed, under the presidency of Andrew Johnston, Grant, as the secretary of war, had a difficult part to play. In 1868 he was elected president, and he retained this office until 1876. His administration dealt generously with the defeated states, and was also noteworthy for the reduction of the national debt and the settlement of the *Alabama* dispute with England. Upon his retirement from office he spent some time in foreign travel. Latterly he became involved in a bubble company which traded upon his name, and in its collapse left him heavily in debt. Overtaken by this calamity he manfully endeavoured to repair his fortunes by writing and publishing his memoirs. This he successfully accomplished, although during his task he suffered greatly from the cancerous disease of which he died.

GRANTHAM, a municipal and parliamentary borough in Lincolnshire, 22¼ miles S.S.W of Lincoln, on the Great Northern Railway, returning one member to Parliament. It is well built, principally of brick, and has besides other places of worship a beautiful Gothic church of the thirteenth century, with

a tower and spire 273 feet high, recently restored. There is also a town-hall. The chief industries are the manufacture of agricultural implements, baskets and wicker-work, and leather dressing. Sir I. Newton received his education at the King Edward VI. grammar-school of Grantham previous to entering Cambridge University. Pop. (1891), mun. bor. 16,746; parl. 17,170; (1901), 17,593 and 18,001.

GRANULATION, the subdivision of a metal into small pieces or thin films by pouring it, when fused, into water. The operation may be effected either by pouring the metal in a fine stream or through a sieve into the water. In any case care must be taken to avoid accidents. It is employed in chemistry to increase the surface, so as to render the metal more susceptible to the action of reagents, and in metallurgy for the subdivision of a tough metal like copper. Small shot is made by a species of granulation.

GRANULATION (*granulatio*, from *granum*, a grain), in surgery. The little, grain-like, fleshy bodies which form on the surfaces of ulcers and suppurating wounds, and serve both for filling up the cavities and bringing nearer together and uniting their sides, are called *granulations*. The colour of healthy granulations is a deep florid red. When livid they are unhealthy, and have only a languid circulation. Healthy granulations on an exposed or flat surface rise nearly even with the surface of the surrounding skin, and often a little higher; but when they exceed this, and assume a growing disposition, they are unhealthy, soft, spongy, and prevent the final healing of the wound. Healthy granulations are always prone to unite.

GRANVELLA, or GRANVELLE, ANTOINE PERRENOT, CARDINAL DE, minister of state to Charles V. and Philip II., was born in 1517, at Ornans, near Besançon. He studied first at Padua, and afterwards applied himself to theology at Louvain. In his twenty-third year he was appointed Bishop of Arras, and accompanied his father to the diet at Worms and Ratisbon, where the labours of both were fruitlessly employed in negotiations for the suppression of the religious commotions of the times. He also assisted at the opening of the Council of Trent, and endeavoured to engage the forces of Christendom in the war against France. In 1550 his father died, and he was appointed by the emperor to succeed him in the office of chancellor. In 1552, when the emperor, having been surprised by Maurice of Saxony in the Tyrol, fled from Innsbruck by night in a litter, Granvella accompanied him with lance in rest. He negotiated the Treaty of Passau with Maurice on 7th August, by which a settlement of the religious difficulties of the empire was effected for a time. In 1553 he negotiated the marriage of Don Philip with Mary queen of England. Philip II. made him his chief minister, as he had been that of his father. In May, 1558, he held a conference with the Cardinal of Lorraine, with a view to negotiate a peace with France. He negotiated the Peace of Câteau-Cambrésis in 1559, by which a marriage was arranged between Philip and Elizabeth, eldest daughter of Henry II. of France, whom the Spaniards subsequently called *Isabel de la Paz*. Philip immediately after quitted the Netherlands, leaving Margaret of Parma as governor, and Granvella as her minister. The creation of several new bishoprics, and the investiture of Granvella in the archbishopric of Mechlin and primacy of the provinces in 1560, led to formidable combinations against him. In 1561 he was made a cardinal. In 1564 he was obliged to yield to the growing discontent in the Netherlands, resign his post, and retire to Besançon. In 1570 Philip sent him to Rome to conclude an alliance with the pope and the Venetians against the Turks, and afterwards to Naples, which was threatened by them, as viceroy. In 1575 he was recalled to Spain, and placed at the head of the government, with the title of President of the Supreme Council of Italy and Castile. In this capacity he negotiated the union of Portugal with Spain; and concluded a marriage between the Infanta Catharine and the Duke of Savoy. In 1584 he was created Archbishop of Besançon. He died at Madrid 21st September, 1586. Guizot, when minister of public instruction in 1834, instituted a commission which published nine volumes of his letters, 1851–62. See Gerlache, Philippe II. et Granvelle (Brussels, 1842).

GRANVELLA, NICOLAS PERRENOT, SIEUR DE, statesman, was born at Ornans, in Burgundy in 1486. He was of a bourgeois family, and took his title from the estate of Granvella, which he purchased in 1527. He studied law at the University of Dôle, and after gaining, through the patronage of Mercurino Arborio, professor at that university, and afterwards chancellor of the empire, the appointment of councillor of the parliament of Dôle, and in 1519 that of master of requests in the imperial chamber of Besançon, he was sent into the Netherlands, and acquired the confidence of Margaret, the governess. He was appointed by her to assist in the Conferences of Calais in 1521. The emperor afterwards sent him as ambassador to Paris, where Francis, who was contemplating a rupture of the Treaty of Madrid, detained him prisoner (1526). On the death of Arborio (Count Gattinara), his early patron, in 1530, he succeeded him in the office of chancellor or seal-bearer of the kingdom of the Two Sicilies, and became the emperor's confidential adviser. He also assisted at the opening of the Council of Trent in 1545, from which he was recalled to preside at the Diet of Worms, held the same year. He exerted himself to procure the accession of the princes and cities to the Interim; and was again present at the Diet of Augsburg in 1550. He died during the sitting of this diet, August 28, 1550.

GRANVILLE, a seaport of France, department of Manche, at the mouth of the Bosq, in the English Channel, 15 miles north-west of Avranches. It consists of the lower town, situated between the station and the harbour, and the upper town, built on a rock projecting into the sea, the latter being surrounded by the old fortifications. The latter portion commands a good view. Its principal structures are a church in the late Flamboyant style, an hospital, and a pier so strongly built as to be capable of mounting cannon. Granville was attacked by the Vendeans in 1793, and bombarded by the English in 1803. It is much frequented for bathing. There is regular communication by steamer with Jersey, forming an agreeable trip. Pop. (1896), 10,380.

GRAPE. See VINE.

GRAPE-SHOT is a combination of small balls put into a thick canvas bag, and cordsd strongly together, or fixed in a kind of cylindrical frame, the diameter of which is equal to that of the ball adapted to the cannon. The number of shot in grape varies according to the service or size of the guns.

GRAPHITE. See PLUMBAGO and CARBON.

GRAPHITIC ACID, a transparent substance, which forms oblique crystals, obtained by long-continued and repeated action of a mixture of chlorate of potassium and the strongest nitric acid upon carefully purified graphite. It is somewhat soluble in water, and combines with the metals, forming salts called *graphitates*. Graphitic acid is apt to detonate when heated, and it is acted on by different reducing agents. See PLUMBAGO.

GRAPHOTYPE, a process of engraving discovered in 1860 by De Witt Clinton Hitchcock, by

which the valuable improvement is effected of enabling the artist to be his own engraver. The discovery was accidental. Mr. Hitchcock was led to it by finding that, on rubbing off the enamel from a visiting-card with a brush and water, the printed letters stood out in relief, the ink having so hardened the enamel that it resisted the action of the brush. Further experiment showed that the same effect would be produced with chalk. The discovery is now utilized in the following manner:—French chalk is by a careful process ground to the finest powder, which is repeatedly passed through a wire-cloth with 10,000 holes to the square inch. It is then laid between a smooth plate of zinc and a smooth plate of steel, and submitted to intense hydraulic pressure, after which it is sized to prepare it for the artist. The pencils used by the artist are of sable-hair, and the ink is composed of lamp-black and glue. The drawing, when finished, is gently rubbed with silk velvet or fitch-hair brushes until the chalk between the ink lines is entirely removed to the depth of $\frac{1}{8}$ inch. The block is then hardened by steeping it in an alkaline silicate, by which the whole of the chalk is converted into stone. Moulds are then taken of it, from which stereotype plates are cast for printing. The zincotype process has superseded graphotype.

GRAPNEL, or GRAPLING, a sort of small anchor, fitted with four or five flukes or claws, and commonly used to fasten boats or other small vessels.

GRAPTOLITES. These fossils, characteristic of the Upper Cambrian, Ordovician, and Silurian strata, are now regarded as belonging to the Cœlenterata, and to that class under which the sea-firs (*Sertularia*, &c.) are arranged. They consist of a rod or axis, which appears solid, but may have been hollow during life, and of cells disposed on both sides of this rod. These cells open one above another in the same vertical plane, while, by the other end, they open into a cavity which is common to all the cells on one side of the axis, this common cavity being characteristic of the Hydrozoa. These fossils seem to have been of horny consistence during life, for they are, with few exceptions, found flattened on the surface of shales and never calcareous. They lived rooted in the mud; not attached to any object, but simply anchored by their base, like the living sea-pens. Graptolites are found—1, presenting the axial rod with a row of cells on one side of it only; these are straight, as in *Graptolithus;* or spirally coiled, as in the genus *Rastrites*. 2. A double row of cells, one row on either side of the axis; these forms constitute the type of *Diplograpsus*, the cells remaining parallel, or the rows parting in the middle line, so as to give a bifurcate aspect. 3. From a common base several series of cells may arise, as in *Climacograpsus*. 4. Two rows of cells may have a common base, but have their cell apertures turned toward each other, as in *Didymograpsus*, the twin graptolite, as if formed by the union of two distinct graptolithi. These are the most familiar forms, but recent investigations have revealed a large number of modifications of plan, the consideration of which belongs to systematic zoology.

GRASLITZ, GREKLIS, or GRADLICZE, a town of Bohemia, circle Elbogen, in a valley between high hills, at the confluence of the Silberbach with the Zwoda, 89 miles W.N.W. Prague. It has a handsome church; manufactures of musical instruments, woollen and cotton cloth, lace, spoons, and articles in wire and brass, a bleachfield, &c. Pop. (1900), 11,803.

GRASMERE, a lake, England, county of Westmoreland, is of an oval form, about 1 mile long by $\frac{1}{2}$ mile broad, and completely surrounded by mountains, presenting beautiful scenery. The village of Grasmere is at the head of the lake.

GRASSE, a town, France, department of Alpes Maritimes, 23 miles E.N.E. of Draguignan. It rises on a slope in the form of an amphitheatre, and has well-built houses, though the streets, owing to the unevenness of the site, are narrow and winding. Its principal buildings are a large Gothic church, a well-arranged hospital, a communal college, theatre, and library. Its manufactures of perfumery are, after those of Paris, the most extensive in France. It is also a winter resort. Pop. (1896), 8,694.

GRASSES (natural order Graminaceæ), a very extensive and important order of endogenous plants, distributed over the whole earth, and comprising many of the most valuable pasture plants, all those which yield corn—such as wheat, barley, and maize, the sugar-cane, and the fragrant andropogons. The whole family of ruminant animals is mainly dependent on different species of grasses for their subsistence. The roots of these plants are fibrous· the stem or culm is usually cylindrical and jointed, varying in length from a few inches to 80 or 90 feet, as in the bamboo (in the sugar-cane the stem is solid, but porous); the stems are coated with silex; leaves, one to each node or joint, with a sheathing petiole; spikelets terminal, panicled, racemose, or spiked; flowers hermaphrodite or polygamous, destitute of true calyx or corolla, surrounded by a double set of bracts, the outer constituting the *glumes*, the inner the *paleæ;* stamens hypogynous, three or six; filaments long and flaccid; anthers versatile; ovary solitary, simple, with two (rarely three) styles, one-celled, with a single ovule; fruit known as a *caryopsis*, the seed and the pericarp being inseparable from each other. Lindley offers the following brief remarks on the qualities of grasses of the pastures:—'Most grasses are saccharine, and nutritious to cattle; but the species of *Holcus*, *Bromus*, &c., are frequently worthless.' Certain kinds of pasture-grasses 'suit the meadows, others marshes, others upland fields, and others bleak and sterile hills, where they furnish valuable food for sheep; these kinds will not grow indiscriminately, or are not equally suitable for different soils and situations; and it is therefore essential for the husbandman that he should be capable of discriminating between them.' The qualities of the soil are indicated by some species; for example, sterile land by *Holcus*, *Dactylis*, and *Bromus;* species of *Festuca* and *Alopecurus* belong to a better soil; while species of *Poa* and *Cynosurus* are found only in the best pasture land. (See HOLCUS, TUSSAC, FESCUE, FOXTAIL, MEADOW GRASS, DOG'S-TAIL GRASS.) As a general rule the grasses are harmless, if not nutritious. *Lolium temulentum*, the darnel, is supposed to be an exception, the seeds possessing a deleterious property, the effects of which have probably been exaggerated. From some experiments of a most testing character brought before the Botanical Society of Edinburgh, it would appear that the seeds are absolutely harmless, and that they become injurious only when they are affected by a species of ergot, as in the case of rye. The writer quoted above remarks, in respect to the noxious property of the darnel, that it seems to make an approach to the quality of half-putrid wheat, which is known to be dangerous. The number of species of grass known to botanists is believed to be little short of 4500. The species described in the British Flora number about 107, with many varieties.

In accompanying plate the following species of grasses are figured, viz.: 1. Common Millet (*Panicum miliaceum*); *a*, panicle, one-half natural size; *b*, *c*, spikelet; *d*, parts of fructification (the glumes and paleæ being removed), three stamens with their versatile anthers, and ovary with two styles having feathery stigmas; *e*, stigma enlarged, showing its

feathery structure, fitted for arresting the pollen discharged from the anther; *f*, the seed, *g*, cross section of seed. 2. Rice (*Oryza sativa*); *a*, part of a stem cut across, with its leafy sheaths and fibrous roots; *a'*, cross section of stem; *b*, panicle, with ripe grains; *c*, *c'*, single grains enveloped in husk, the latter with its awn, both slightly magnified. 3. Sweet-scented Vernal-grass (*Anthoxanthum odoratum*); *a*, spikelet magnified, showing its two stamens and two styles. 4. Italian Millet (*Setaria Italica*); *a*, cluster of spikelets, natural size; *b*, three spikelets in different stages of development. 5. Rye (*Secale cereale*) spike in flower; *a*, glumes and anthers; *b*, a grain with embryo, lenticular, external, lying on one side, at the base of the farinaceous albumen; *c*, embryo viewed anteriorly; *d*, longitudinal section of grain; *e*, longitudinal section of germinating grain; *f*, embryo developed. 6. Darnel (*Lolium temulentum*), supposed to be the Tare of Scripture; a common weed in England, rare in Scotland. 7. Maize or Indian Corn (*Zea mays*), showing the upper part of a plant in flower, greatly reduced; *a*, staminiferous or male spikelet; *b*, female flower bearing the stigmas; *c*, head or cob reduced; *d*, fruit in longitudinal section. 8. Bamboo (*Bambusa arundinacea*). 9. Sugar Cane (*Saccharum officinarum*); *a*, pieces of stem, one-third natural size; *b*, spikelet magnified. 10. Pampas-grass (*Gynerium argenteum*). The plate also gives several illustrations of plants belonging to the Cyperaceæ or Sedges, a natural order whose affinities are with grasses. (See CYPERACEÆ.) Fig. 11 is the Cotton-grass (*Eriophorum latifolium*), with cymose spikelets; *a*, flower with three stamens; *b*, triquetrous fruit cut across, magnified. 12. Edible Cyperus or Rush-nut (*Cyperus esculentus*). 13. Papyrus (*P. antiquorum*), the Bulrush of Scripture, used in former times for making boats, ropes, and paper. Fig. 14 is the Hairy Wood-rush (*Luzula pilosa*), which belongs to the Juncæ, the natural order of the Rushes. The plate shows a stem with leaves, and a flower-head in the form of a cyme, with capillary branches and pedicels; *a*, flower with broad short bracteoles; *b*, flower expanded; *c*, capsule burst open, three-valved, three-seeded; *d*, seed with a terminal appendage. Fig. 15 is the Sea-grass or Grass-wrack (*Zostera marina*). See GRASS-WRACK.

GRASSHOPPER. See LOCUST.

GRASS-TREE (*Xanthorrhœa hastilis*), an interesting and peculiar plant belonging to the natural order Liliaceæ. Its presence is generally indicative of a poor soil, and it is one of those plants which give life to the sterility of a great portion of Australia. It is an endogenous plant, and attains its height from the annual decay of its long grass-like leaves, from the centre of which proceeds the flower-stalk, having in every way the form and structure of the bulrush. The bush-fires which sweep through the country almost always scorch the crooked stems of these plants black, so that in the distance they have very much the appearance of aborigines crouching down. The natives sometimes use this resemblance to escape detection when pursued. When torn up by the roots after frequent burnings these trees afford a quantity of resinous gum, called gum acaroides, which is used for making varnish, and by the natives for fastening on the barbs of their spears, made of fishes' teeth or broken glass.

GRASS-WRACK, or SEA-GRASS (*Zostera marina*), a phanerogamous plant belonging to the Naiadeæ, remarkable for growing at the bottom of the sea where it is of no great depth, forming green beds side by side with the sea-weeds. It is common enough on the British coasts and on those of the greater part of Europe. It receives its name of sea-grass from its grassy appearance, though it has no connection with the grasses proper. When dried it is used for stuffing pillows and mattresses, and for packing goods liable to be broken; and it is also burned, in order to extract the soda which it contains. We give a figure of this plant in the plate at GRASSES; *a* being the fruitful, *b* the unfruitful plant, reduced; *c*, stem, with long, sheathing, linear leaf, bearing flowers in two parallel series of alternating anthers and ovaries on one surface of a pedicelled leaf-like spathe, natural size; *d*, ovoid seeds, magnified; *e*, pistil or carpel with two stigmas; *f*, fruit; *g*, seed, magnified.

GRATE, an open frame of iron bars, used for burning coal as fuel. An open fire-place necessarily burns coal more rapidly than a stove, while it has other advantages which render it more popular. A considerable part of the fuel is lost in the form of smoke, and much of the heat generated is radiated up the chimney instead of being sent into the room. Considerable improvements have been effected in the old methods of constructing grates, particularly by making in connection with the grate a metal neck to the chimney, which is thus considerably contracted, while the fire-place is projected further forward, and the heat thrown out more effectually. See WARMING.

GRATIAN (*Franciscus Gratianus*), a Benedictine of the twelfth century, was a native of Chiusi, and was the author of a famous work, entitled Decretum; or, Concordia discordantium Canonum, in which he endeavours to reconcile those canons that seem to contradict each other. The errors of this work, which are not a few, have been exposed by subsequent writers. It is, however, a rich storehouse of the canon law of the middle ages. The best edition of the text is found in the Corpus Juris Canonici of Richter (Leipzig, 1833–39).

GRATIANUS, eldest son of the Emperor Valentinian by his first wife Severa, was born at Sirmium in Pannonia, A.D. 359, and when only eight years of age was raised by his father to the rank of Augustus. His education appears to have been conducted with care, chiefly by the poet Ausonius, to whom he afterwards expressed his gratitude by bestowing upon him the office of consul On the sudden death of Valentinian in 375 the eastern part of the empire still remained subject to Valens, and Gratian was not even allowed to possess the western part undivided, but by the decision of the troops was obliged to share it with a half-brother, a child of four years old, who was associated with him under the title of Valentinian II. In the early part of his reign the Goths and Alemanni made incursions into the Danubian provinces and into Gaul. They were repeatedly defeated by Gratian and his generals, but they also advanced into the Eastern empire, and defeated and killed Valens near Adrianople, August, 378. Gratian bestowed the eastern empire upon Theodosius, one of his generals. He was deserted by his soldiers while leading them against Maximus, whom the legions in Britain had saluted emperor, and after sustaining a defeat near Paris, was overtaken at Lyons while fleeing back to Italy, and put to death in the eighth year of his reign. He is said to have wanted energy to rule the empire, and to have persecuted both heathens and heretics.

GRATINGS (nautical), in ships, a sort of open cover for the hatches, resembling lattice-work, serving to give light to the lower apartments, and to permit a circulation of air, both of which are particularly necessary when, from the turbulence of the sea, the ports between decks are obliged to be shut.

GRATTAN, HENRY, an eminent Irish orator and statesman, baptized at Dublin, 3rd July, 1746. He finished his education at Trinity College, whence he

removed to England, and became a student in the Middle Temple in 1767. He was called to the Irish Bar in 1772, and in 1775 was elected member for Charlemont in the parliament of Ireland. He immediately became distinguished in the opposition, and infused that spirit into the country, which in two years aroused 80,000 volunteers, and produced in 1782 a repeal of the statute of 6th George I., which had enacted that the crown of Ireland was inseparably connected with that of Great Britain; that Ireland was bound by British acts of Parliament when named therein; that the Irish house of lords had no jurisdiction in matters of repeal; and that the last resort in all cases of law and equity was the British House of Lords. For his share in the acquirement of this concession the Irish parliament voted him £50,000 and a house and lands for him and his heirs for ever. Two or three sessions of great parliamentary exertion followed, which were distinguished by the rivalry of Messrs. Grattan and Flood, and terminated in the confirmed ascendancy of the former, who became the leader of the country party in the House of Commons, and the head of the Irish Whigs. In 1790, although already avowedly jealous for concessions to the Catholics, Mr. Grattan was returned for the city of Dublin, and remained an active senator until the premature recall of Earl Fitzwilliam. Disgusted by the policy which followed, and by the Irish rebellion and its manifold horrors, he temporarily seceded from Parliament, and lived in retirement. The project of a union being brought forward by Mr. Pitt, he once more obtained a seat in Parliament for the purpose of opposing it. When it was carried, however, he did not refuse a seat in the united House of Commons, being returned in 1805 for the borough of Malton in Yorkshire, and in the following year for Dublin. He supported the war policy of the administration, but the later years of his parliamentary attendance were chiefly occupied in a warm and energetic support of Catholic emancipation. He died in the service of this cause; for being unanimously called upon by the Catholic body to carry their petition to England, and to present and support it in the House of Commons, when the exertions were represented by his friends as incompatible with his age and declining health, he nobly replied that 'he should be happy to die in the discharge of his duty.' He did in fact die soon after his arrival in London, June 4, 1820. His remains were interred in Westminster Abbey. Grattan was the zealous friend of Ireland from first to last. In private life he was a warm friend, sometimes a bitter opponent. As a public speaker he had to contend with a defective voice; but his eloquence was bold and commanding, combining strength with beauty, and energy and elevation with elegance. The best collection of Grattan's parliamentary speeches is that edited in 1822 by his son Henry, who also wrote an account of his Life and Times (1839–46). See Lecky's Leaders of Public Opinion in Ireland (1871) and Dunlop's Henry Grattan (1889).

GRATZ, or GRAZ (Latin, *Gratium*; Slavonic, *Nimetzki-Grad*), a town of Austria, capital of Styria, picturesquely situated on both sides of the Mur, about 140 miles south-west of Vienna by rail. The older part of the town, now called the 'inner town,' stands on the left bank of the river, surrounded by fine gardens and pleasure-grounds, and overlooked by the Schlossberg. With the suburbs on the right bank of the river communication is maintained by several bridges. The ancient fortress or Schlossberg rises 400 feet above the river, but the fortifications which surrounded the town have given place to avenues and pleasure-grounds. The public edifices include a cathedral, and numerous churches and monasteries. The Dom or cathedral, built in 1456, is a majestic Gothic structure with a pavement of marble, a superb high altar, and several fine frescoes, statues, and paintings; near the cathedral is the mausoleum of the Emperor Ferdinand II., a neglected chapel, in the Italian style, where, through an opening in the coffin-lid, is shown a little dust, the only mortal remains of that relentless persecutor of the Protestants. The university, founded in 1586, possesses a library with some 130,000 volumes, has over 100 teachers, and is attended by about 1500 students. The Johanneum, a technical college, so called from its founder Archduke John, is a noble institution, originally designed to encourage art, science, and manufactures. The town possesses also a provincial library of 140,000 volumes, a museum with natural history and other collections, and a picture gallery. The industries are varied, comprising iron and steel goods, rails, wire, wagons, glass, candles, soap, cloth, felt, leather, paper, boots and shoes, &c. The trade is important. Telephones and the electric light have been introduced. Gratz is the see of a bishop, and the seat of the superior courts and offices of the duchy. The environs afford numerous fine promenades, and the town and neighbourhood form a favourite holiday resort. Gratz is a place of considerable antiquity. Pop. (1880), 97,791; (1890), 112,771; (1900), 138,570.

GRAUBÜNDEN. See GRISONS.

GRAUDENZ, a town of Germany, province of West Prussia, in a fertile plain on the right bank of the Vistula, here crossed by a long railway bridge, 20 miles s.s.w. of Marienwerder. It has several churches, two synagogues, gymnasium and other schools, orphanages, &c. The manufactures include iron, machinery, boots and shoes, carpets, tobacco, carriages, and there are breweries and distilleries. The fortress of Graudenz, situated outside the town, after being neglected for a time, has been greatly strengthened recently. Pop. in 1900, 32,727.

GRAVEL. See STONE.

GRAVELINES, a fortified seaport of France, department of Nord, in a marshy district, 11 miles west of Dunkirk, near the mouth of the Aa in the English Channel. Fishing is the chief industry; and some trade is also carried on by sea, chiefly with England. Pop. in 1901, 6202.

GRAVER. See ENGRAVING.

GRAVESANDE, WILLIAM JAMES VAN 'S, an eminent Dutch mathematician and natural philosopher of the eighteenth century. He was born in 1688, at Bois-le-Duc, and studied the civil law at the University of Leyden, where he took his doctor's degree in 1707. He settled at the Hague, and practised as a barrister; but his attention was much engrossed by mathematics and physics, on which subjects he published some dissertations in the Literary Journal of the Hague, in the conduct of which he was concerned. In 1715 he was appointed secretary to the embassy sent by the states-general to England to congratulate George I. on his accession to the crown. On this occasion 'sGravesande formed an acquaintance with Sir Isaac Newton, and was chosen a fellow of the Royal Society. On his returning home he became professor of mathematics and astronomy at Leyden, where he first taught the Newtonian philosophy. In 1721 he went to Cassel, at the request of the Landgrave of Hesse, to examine the famous wheel of Orffyreus, a professed exhibition of the perpetual motion. He himself considered it not necessarily impossible to prepare a machine which should contain in itself a principle of perpetual motion. In 1734 he received the chair of philosophy, which he filled with much distinction. The death of two promising sons threw him into a lingering illness, of which he died in 1742, aged fifty-five. To his labours

in the cause of science as a lecturer he added the publication of several works, which contributed to make known the discoveries of Newton, and extend the boundaries of knowledge. Among these were Physices Elementa Mathematica Experimentis confirmata, sive Introductio ad Philosophiam Newtonianam (1720), translated into English by Dr. Desaguliers; Matheseos universalis Elementa (1727, 8vo), and Introductio ad Philosophiam, Metaphysicam et Logicam (1736).

GRAVESEND, a municipal and parliamentary borough of England, in the county of Kent, not far from the mouth of the Thames, 24 miles east of London. It is a great rendezvous for shipping. The numerous vessels which usually lie at anchor in the river keep up a constant influx of seamen and strangers. The bathing establishment draws additional visitors in the summer season; and from all these circumstances this town presents a continued scene of bustle and activity. On the opposite side of the river is Tilbury Fort. Gravesend is the boundary port of London, where vessels arriving from foreign countries deliver their manifests and take in revenue officers. It is a place also where troops and passengers embark. The chief edifices are the fine town-hall, several churches, the recently-built public hall, the municipal technical school, containing the public library, the hospital, sailors' home, barracks, jubilee clock-tower, &c. The chief industries are ship-building, brewing, soap-making, brick-making, iron-founding, while fishing, chiefly of shrimps, is carried on to some extent. Market-gardening and the growing of hops and fruits are extensively carried on. It returns one member to Parliament. Pop. (1891) of mun. bor. 23,876; parl. bor. 35,079; (1901), 27,175 and 39,766.

GRAVINA, a town of South Italy, in the province and 34 miles south-west of Bari, on the left bank of the Gravina. It is a bishop's see, has a cathedral, and was anciently a place of considerable strength. It was besieged unsuccessfully by the Saracens in 975. Pop. (1901), 18,685.

GRAVINA, Giovanni Vincenzo, Italian jurist and man of letters, was born at Roggiano, a castle in Calabria, in 1664. He studied law at Naples, and afterwards resided at Rome. In 1699 he was appointed professor of civil law at the College della Sapienza, and in 1703 he succeeded to the chair of canon law and the exposition of the decretals. He gained great reputation by his writings, which were numerous. The principal, Origines Juris Civilis, is considered a classical work, replete with learning. To the Naples edition, printed in 1713, was subjoined a treatise, De Imperio Romano, also highly esteemed. He was also the author of Institutes of Civil and Canon Law; some treatises; Della Tragedia; Della Ragion Poetica; De Institutione Poetarum, and five tragedies, written on the model of the ancients, which were not favourably received. He died in 1718.

GRAVING, the act of cleaning and repairing a ship's bottom, as when she is laid aground, during the recess of the tide; but this is usually done in a *graving-dock*. See Dock.

GRAVITATION. The law of gravitation is the law discovered by Newton, according to which every portion of matter attracts every other portion with a force directly proportional to the product of the two masses, and inversely proportional to the square of the distance between them. Kepler had given the laws, deduced from observation, according to which the planets describe their orbits. From these Newton deduced the laws of the force in the case of the planets; and subsequently he generalized the statement of them, by showing the identity of the nature of the force that retains the moon in her orbit, and that which attracts matter near to the surface of the earth. Kepler's laws state, *first*, that every planet revolves round the sun in an ellipse, of which the sun occupies one focus; *second*, that the velocity of any planet at different parts of its orbit is such that the radius vector from the sun to the planet sweeps over equal areas in equal times; and *third*, that the distances of the various planets are so related to the periods of their revolution that the squares of the periodic times are proportional to the cubes of the mean distances from the sun. From these laws Newton made the following deductions:—He inferred from the second law that the planet is acted on by a *central* force that is always directed towards the sun. From Kepler's first law he deduced the law of variation of the force for any one planet, and found that the force varies inversely as the square of the distance of the planet from the sun. Lastly, he concluded from Kepler's third law a relation between the forces on the various planets, namely, that the forces on equal masses of the different planets are inversely proportional to the squares of the distances of those planets from the sun. This law indicates the identity of the nature of the force that acts on the different planets. Newton next proceeded to consider the motions of the moon; and to ask the question, Is not the force that causes the moon to fall in towards the earth the same as that which influences falling bodies near to the earth's surface? This question he attempted to put to the test of calculation. At first he was unsuccessful. The then received estimate of the dimensions of the earth were so far from correct that the comparison between the force of attraction in a stone and that in the moon at her distance from the earth did not countenance his theory even approximately, and he was obliged to give it up for nearly twenty years. It was not till 1684, when he heard a paper of Picard read at the Royal Society of London, on new geodetical measurements of the earth, that he obtained accurate data to work with: and, returning home, he set to work to examine the question afresh. It is related that, when working out the figures which finally led to his great discovery, and seeing them gradually indicating the result expected, he became so impressed with the magnitude of the issue, and so intensely affected, that he was unable to finish the calculation himself, and was obliged to hand it over to a friend, who completed it.

The application of the grand law that he had discovered subsequently occupied a large part of the mathematical labours of Newton. Attacking the problem of *lunar inequalities*, he accounted for them by considering the perturbations due to the attraction of various bodies of the solar system, and by accounting for all the observed perturbations by means of his newly-discovered law, he confirmed the truth of the law itself in such a way as to put it beyond all question.

Having established the law of gravitation throughout the solar system, it was natural to infer the universality of its action. We know on the one hand, by observing the motion of the planets and satellites, the asteroids and the comets, that the law holds with great exactness for all these bodies; on the other hand, experiments of Cavendish with balls of lead, and of others, verify its exactness down to very short measurable distances: and though we are unable with our present appliances to determine the orbits of double stars and of other stellar systems, still we seem to be fully justified in assuming that in these cases also the law stated above holds, at the least, very approximately.

We must here devote a few sentences to a point respecting the law which is almost universally passed over without even an allusion being made to it, although it is one of the most important questions with respect to the construction of any theory to account for gravitation. The point to which we refer is the exact proportionality of the gravitating forces of any two bodies to their masses. The minutest experiment shows no deviation from the exactness of this law; nor has the most accurate observation of planetary bodies sufficed to detect any such deviation. This is the fact proved by the well known guinea and feather experiment, in which it is shown that though a mass of gold and a feather do not fall equally fast under ordinary circumstances, because of the unequal resistance of the air in the two cases, yet that, the air being removed by means of the air-pump, they fall with equal velocity. The experiment proves that the force of gravity in the two cases is exactly proportional to the mass of the guinea and of the feather. Newton showed the same thing himself with far greater minuteness by vibrating balls of various materials similarly suspended. In this, which is known as Newton's pendulum experiment, it is shown that pendulums of equal length vibrate in equal times whatever be the material and the masses of which the bobs of the pendulum are made. By the experiment just mentioned, when performed with all the nicety at our command, it is probable that any deviation amounting to a ten-thousandth or a hundred-thousandth part of the whole amount considered could be detected. Planetary motions prove the law to even a greater degree of accuracy. It is curious that this portion of the law, *though it is only proved by experiment and observation*, is hardly ever, if ever, referred to by popular writers. It is either assumed without pretence of proof, or is passed over without remark.

Of theories that have been put forward to account for gravitation the most important is that of Le Sage. Our limits will not permit us to give an account of it here. We must refer our readers to a paper on the subject which was communicated by Lord Kelvin to the Royal Society of Edinburgh in 1871. The most formidable difficulty that Le Sage's theory has to encounter is the *exact* proportionality of gravity to mass. It must be said of the theory that observation has not yet justified the holders of it; and to this extent we are yet without any theory that we can really consider as affording a probable explanation of gravitation.

GRAVITY, Force of. The determination of the force of gravity from point to point over the earth's surface is a matter of importance. The force of gravity is not the same all over the surface of the earth. It is least at the equator, and it gradually increases as we recede toward the poles. Thus a given mass, if tested by means of a spring-balance of sufficient delicacy, would appear to weigh least at the equator, and would seem to get heavier and heavier as the latitude increases. This is due to two causes: first, owing to the rotation of the earth on its axis every particle of matter tends to fly off from the surface by centrifugal force. The apparent force of gravity at any place is therefore the force of gravity at that place diminished by the centrifugal force. The centrifugal force at the equator is greater than that in high latitudes, because of the greater radius of the circle described at that place. The second cause is the oblate form of the earth. The earth is not a true sphere, but is flattened at the poles. Hence the distance of any attracted point at the equator from the centre of the mass is greater than that of points situated at or near to the poles; the attraction is therefore less at the equator than in high latitudes. Experiments to determine the force of gravity from point to point are made by determining the length of a pendulum that beats seconds at each place. This being known, the force of gravity is easily calculated. See Pendulum.

By experiments made by Captain Kater, at Leith Fort, it is found that the force of gravity at that place is such that a body, unresisted by air or otherwise, would acquire in one second, under its influence, a velocity of 32·207 feet per second. In latitude 55° 33′, which is approximately that of Edinburgh, the number is 32·2 exactly. The variation in the force of gravity for a change of latitude of 1° northward or southward, in our latitudes, is approximately 0·0000832 of its own amount. The following table gives the lengths of the seconds pendulum at different places, as determined by various experimenters, and also the force of gravity as deduced from their observations.

The Value of the Accelerating Force of Gravity at Different Places.

Observer.	Place.	Latitude.	Length of seconds pendulum in inches.	Accelerating force of gravity—feet per second.
Sabine	Spitzbergen	N. 79° 50′	39·21469	32·2528
Sabine	Hammerfest	N. 70° 40′	39·19475	32 2363
Svanberg	Stockholm	N. 59° 21′	39·16541	32·2122
Bessel	Königsberg	N. 54° 42′	39·15072	32·2002
Sabine, Borda	Greenwich	N. 51° 29′	39·13983	32·1912
Biot and Sabine	Paris	N. 48° 50′	39·12851	32·1819
Biot	Bordeaux	N. 44° 50′	39·11296	32·1691
Sabine	New York	N. 40° 43′	39·10120	32·1594
Freycinet	Sandwich Islands	N. 20° 52′	39·04690	32·1148
Sabine	Trinidad	N. 10° 39′	39·01888	32·0918
Freycinet	Rawak Island (Pacific)	S. 0° 2′	39·01433	32·0880
Sabine and Duperrey	Ascension	S. 7° 55′	39·02363	32·0956
Freycinet and Duperrey	Isle of France	S. 20° 10′	39·04684	32·1151
Brisbane and Rumker	Paramatta	S. 33° 49′	39·07452	32·1375
Freycinet and Duperrey	Falkland Islands	S. 51° 35′	39·13781	32·1895

GRAY, a town, France, department of Haute-Saône, on a hill overlooking a beautiful meadow, watered by the Saône, 27 miles south-west of Vesoul. It rises like an amphitheatre, but is much more attractive at a distance than on actual inspection. The principal buildings are the parish church, town-house, courthouse, communal college, cavalry barracks, and ancient castle. The manufactures are hair-cloth, Paris paint, starch, glue, leather, and refined wax; and there is a considerable trade in corn, wine, iron, and timber. Pop. (1896), 5673.

GRAY, Thomas, a distinguished English poet, was the son of a money scrivener in the city of London, where he was born in 1716. He was sent to Eton, and there laid the foundation of his future intimacy with Horace Walpole and Richard West. In 1734 he removed to Cambridge as a student of St. Peter's College, where he early obtained some reputation for

literature and poetry. He quitted college in 1738, and entered himself at the Inner Temple with a view of studying law, but was easily induced to accept the invitation of Mr. Walpole to accompany him in his tour of Europe, towards the close of which they separated, in consequence of some disagreement. Gray finished the expedition by himself, and returned to England in 1741. His father soon after died, and leaving but a small property, Mr. Gray returned to academic retirement at Cambridge. Here he continued for several years, occupying himself with forming magnificent literary schemes, which he admirably commenced but wanted energy to mature. So slow was he to publish, that it was not until 1747 that his Ode on a Distant Prospect of Eton College made its appearance; and it was only in consequence of the printing of a surreptitious copy that, in February, 1751, he published his Elegy written in a Country Churchyard. It went through four editions in two months. In 1757, on the death of Cibber, the office of laureate was offered to Mr. Gray, who declined it, and next year he published his two Pindaric odes, On the Progress of Poesy, and The Bard. These odes have never been popular, but many critics of high reputation have expressed the warmest admiration for them. In 1759 he removed to London, where he resided for three years. In 1768 the Duke of Grafton presented him with the professorship of modern history at Cambridge; in consequence of which he wrote the Ode for Music, for the installation of that nobleman as chancellor of the university the following year. It was the intention of Gray to do something more than his predecessors, who had made the office a sinecure, although it afforded a salary of £300 per annum; but his health soon after declining, he proceeded no farther than to sketch a plan for his inauguration speech. He died of gout in the stomach, on the 30th July, 1771, in his fifty-fifth year, and was buried with his mother in the church-yard of Stoke Poges, in Buckinghamshire. As a poet, Gray is lofty, energetic, and harmonious. Although lyric poetry was what he chiefly cultivated, he would have excelled in the didactic, if a judgment may be formed from his noble fragment of An Essay on the Alliance of Education and Government. As a writer of Latin verse he is surpassed by few, and his letters are admirable specimens of the epistolary style. In his private character he was of a friendly and affectionate, though somewhat fastidious disposition, which gave an air of effeminacy and timidity to his manners, subjecting him to much ridicule, at the same time singularly contrasting with the manly strains of his poetry. His general acquirements were uncommon, but his want of energy and perseverance rendered his extensive research little effective. In 1884 Mr. Edmund W. Gosse issued a complete edition in four volumes of Gray's works, both prose and verse, together with nearly 350 letters. See Gosse's Life of Gray, and Ward's English Poets (vol. 3). Hazlitt says of the letters that they are 'inimitably fine'.

GRAYLING (*Thymallus vulgaris*), a fish inhabiting the streams in certain parts of England, and also met with in some Scottish streams. It is scattered over Europe from Lapland to North Italy, and also over part of Asia, but it is doubtful if the Scandinavian species is the same as ours. The grayling prefers rapid streams where the water is clear and cool, and the bottom sandy or pebbly, and it requires on the whole deeper water than the trout, to which it has a certain similarity in some of its habits. It rarely takes the minnow, a bait of which the trout is very fond, and it is much more easily caught than the latter. It spawns about the month of April, the roe being cast on stones and gravel without being buried. By the end of July or the beginning of August the young fishes are already four or five inches long, and about October they have attained half their full-grown size. It is an excellent fish for the table, and is not long out of season. It is at its best in October and November. The grayling sometimes, but seldom, attains the size of 3 or 4 lbs. The general colour is yellowish-brown, including the fins; several deeper brown lines run along the body; under the belly white. The fish is liable to much diversity of colour in different streams. The fish is said, when newly caught, to have a smell resembling that of wild thyme. It should be cooked soon after it is taken from the water, as the peculiar flavour is very evanescent.

GRAZALEMA (ancient, *Lacidulemium*), a town of Spain, in Andalusia, on a slope at the foot of a sierra of the same name, 58 miles E.N.E. of Cadiz. It is indifferently built, but has a large and handsome Gothic church and four hermitages, one of which, being a strong and massive structure, was successfully employed by the inhabitants during the Peninsular war as a place of defence against an incursion of the French. The manufactures, more important than usual in Spanish towns, consist of woollen and linen cloth, flannel, soap, and leather, ordinary and cordovan. Pop. (1897), 5220.

GREAT BAHAMA. See BAHAMAS.

GREAT BRITAIN. See the articles BRITAIN, ENGLAND, and SCOTLAND.

GREAT CIRCLE SAILING, or TANGENT SAILING, a method of navigating a vessel according to which her course is always kept as nearly as possible on a great circle of the sphere, that is, a circle which has for its centre the centre of the sphere. It is well known that an arc of such a circle joining two places gives the shortest distance between them, consequently the course of a vessel sailing on this arc will be the shortest possible. It is of course impossible, on account of winds, currents, &c., to keep a vessel strictly to such a track, but the navigator ought to endeavour to do so as much as possible, and to make all his deviations short tangents to the circle on which he wishes to sail. A simple instrument called a spherograph is employed for finding the great circle course between places, and this is accompanied by tables compiled for the same purpose.

GREAT FISH RIVER, a river of south-east Africa, in the eastern portion of Cape Colony. It rises in about lat. 31° 30′ S.; lon. 25° E., and falls into the sea at lat. 33° 30′ S.; lon. 27° E. Its course, like that of most of the rivers in this part of Africa, is singularly tortuous, its course in a straight line not perhaps exceeding 180 miles, while with sinuosities it will extend to considerably over 400. It seldom runs in winter, but after heavy thunder-storms in the mountains it will sometimes rise 25 or 30 feet in a few hours.

GREAT MARLOW, a parish and market-town of England, in the county of Bucks, on the Thames, over which there is a suspension bridge, 5 miles N.N.W. of Maidenhead. Manufactures: chairs, lace, and paper. Previous to 1885 it returned one member to Parliament. Pop. (1891), 4212; (1901), 4526.

GREAT SALT LAKE, an intensely salt lake of the United States, in the state of Utah, about 4250 feet above sea-level, some 70 or 80 miles long and 30 to 50 wide, and very shallow; but its depth and area vary greatly according to the rainfall. It has several islands, which, with its shores, are whitened by the salt; and it receives the Bear and several other streams. A brine shrimp and the larva of a fly live in it, but it contains no fish.

GREAT ST. BERNARD. See BERNARD (GREAT ST.).

GREBE (*Podiceps*), a genus of aquatic birds, five species of which are found in Britain. The grebes have the bill of moderate length, straight, and pointed; the legs and feet long, and placed far back, so that when standing the body of the bird is in an upright position; three toes in front, one behind, anterior toes very much flattened, united at the base, and surrounded by an extended membrane; no true tail; wings short. The great crested grebe (*P. cristatus*) is the largest of the genus. It is generally distributed throughout Great Britain and Ireland, wherever there is a large enough piece of water and sufficient aquatic vegetation for cover. It is also found in most parts of Europe, in various parts of Asia and Africa, and in North America. The bird is generally seen on the water or in its immediate vicinity. The nest is built of decaying water plants, almost level with the surface of the water, and is generally wet. The eggs are usually four in number and white. When there is any appearance of danger the old birds take their young under their wings and dive below the water. The general colour of the upper parts, including the wings, is dark brown; the front of the neck and all the under parts are of a shining silky white, so that the bird is sometimes called the satin grebe; the top of the head and the crest feathers are dark brown, cheeks white, ear-tufts reddish chestnut, becoming dark chestnut at the ends; length, 21 to 22 inches. The skin of this grebe is made into muffs and trimmings for ladies' dress. The smallest and most common of the British grebes is the dabchick or little grebe (*P. minor*). It is not so common in Scotland, however, as in England and Ireland. It frequents rushy or reedy lakes, ponds, or streams, often migrating to the mouths of rivers or to retired bays in winter. It feeds on small fishes, water-insects, and vegetable substances, also shrimps, fish-fry, &c.; builds a large flat nest of aquatic plants, and lays four to six white eggs, which soon become stained with greenish yellow and brown. The female seldom leaves her eggs without covering them over with vegetation—no doubt for the purpose of concealing them. The head, back of the neck, and all the upper surface of the body is very dark brown, almost black; cheeks, sides, and upper front part of the neck reddish chestnut; under surface, dull grayish white; length, 9½ inches. The red-necked grebe (*P. rubricollis*) is only a winter visitant in this country. It is smaller than the great crested grebe, and larger than the horned or Sclavonian grebe (*P. cornutus*), also found in Britain, and has a longer and stronger bill in proportion to its size than the other British species; it is also more decidedly marine in its habits. The horned grebe is rather rare in England in summer, commoner in winter. It frequents the coast and fenny districts. The rarest British species is the eared grebe (*P. auritus*), so called from the reddish or orange-yellow feathers which arise behind the eye and cover the ears See illustration at ORNITHOLOGY

GREECE, ANCIENT. The name of *Græcia* originated in Italy, and was probably derived from Pelasgian colonists, who, coming from Epirus, and calling themselves *Græci*, occasioned the application of this name to all the people who spoke the same language with them. In earlier times, for example, in the time of Homer, Greece had no general name among the natives. It afterwards received the name of *Hellas*, and still later, after the country was conquered by the Romans, the name of *Achaia*. The Grecian tribes were so widely dispersed that it is difficult to determine with precision the limits of Greece, properly so called. The name is properly applied only to the country lying to the south of Macedonia, with the adjacent islands; but it has sometimes been given by modern geographers to the whole territory lying to the south of Mount Haemus, Mount Scomius, and the Illyrian Alps, or the whole series of mountains now called the Balkan, so as to include regions inhabited by some Thracian, Macedonian, and Illyrian tribes. The area of the mainland of the more limited region to which the name of Greece is properly confined is above 20,000 square miles.

Physical Features.—Taken in the narrower acceptation of the term, the first thing which strikes the eye on looking at a map of Greece is the comparatively great extent of its coast-line, formed by numerous gulfs which penetrate into it in all directions, and give it a remarkably broken and rugged appearance. Proceeding round the coast from the north-west to the north-east we are presented in succession with the Ambracian Gulf (now Gulf of Arta), Corinthian Gulf (the mouth of which is now called the Gulf of Patras, while the name of Gulf of Corinth is reserved for the inner part of it), the Cyparissian (now Arcadian) Gulf, and the Messenian, Laconian, Argolic, Saronic, Maliac, and Pagasæan Gulfs, now called respectively Koron, Kolokythia or Marathon, Nauplia, Athens or Ægina, Molo or Zeitouni, and Volo. The Corinthian Gulf on the east, and the Saronic Gulf on the west, which nearly meet at the Isthmus of Corinth, divide Greece into a continental and a peninsular portion, the latter called the Peloponnesus (now Morea). Another striking feature is the mountainous character of the interior. The whole country to which we have restricted the name of Greece was bounded on the north by a range of mountains, the western half of which was called Mount Lingon and the eastern half the Cambunian Mountains, with Mount Olympus at their eastern extremity. From about the middle of this range a lofty chain, called Mount Pindus, strikes southwards and runs almost parallel to the eastern and western coasts of Greece. At a point in this chain, called Mount Tymphrestus or Typhrestus (now Mount Velukhi), two chains proceed in an easterly direction, the northernmost of which, Mount Othrys, runs almost due east, and attains at some points a height of from 7000 to 8000 feet, while the southern one runs rather in a south-easterly direction, attaining at one point a height of 8240 feet, and terminates at the celebrated pass of Thermopylæ. The Cambunian Mountains on the north, the range of Pindus on the west, and Othrys on the south, inclose the large and fertile vale of Thessaly, forming the basin of the Peneus (now Salambria), and the ranges of Othrys and Oeta inclose the smaller basin of the Sperchius (Hellada). Another range of mountains branches off from Mount Œta and runs still more to the south. This is the celebrated Parnassus, which, at its highest point, exceeds 8000 feet. The peaks of Cithæron, Parnes, Pentelicus, and Hymettus lie in the same direction, but are more distinguished for their classic celebrity than for their height. The range in which these peaks are found is continued to the south-east point of continental Greece, and the islands of Ceos, Cythnos, Seriphos, and Siphnos (now Zea, Thermia, Serpho, and Siphanto) may be regarded as continuations of it. This range on the south and that of Œta on the north inclose the basin of the Cephissus, with Lake Copais (now drained). Another chain of mountains strikes southwestwards from the central range of continental Greece, under the names of Ccrax and Taphiassus. The chief rivers on the west side of the Pindus chain are the Arachthus (now Arta) and the Achelous (now Aspropotamo).

The chief feature in the mountain system of the Peloponnesus is a range or series of ranges forming a circle round the valley of Arcadia in the interior, having a number of branches proceeding outward from it in different directions, dividing the rest of

the Peloponnesus into several other valleys. The loftiest part of the mountainous circle round Arcadia is that lying to the north, with the peak of Cyllene (Zyria), 7788 feet high, at its eastern extremity, and Erymanthus (Olonos), 7297 feet high, at its western. The southern part consists rather of a series of heights than a chain of mountains. The highest range which branches off from the circle round Arcadia, and, indeed, the highest range in the Peloponnesus, is Mount Taygetus, which strikes southwards, separating the ancient divisions of Messenia and Laconia, and terminating in the promontory of Tænarum (now Cape Matapan). The other chains are of no importance. The only rivers in the Peloponnesus of any consequence are the Eurotas (Basilipotamo), draining Laconia on the south-east; the Pamisus (Pirnatsa), draining Messenia on the south-west; the Alpheus (Ruphia), draining Arcadia and Elis; and the Peneus, draining Elis on the west.

The rock most largely developed in the mountains of Greece is limestone, which often assumes the form of the finest marble. Granite and gneiss are found only in the north, in the eastern ramifications of the Pindus. Tertiary formations prevail in the north-east of the Peloponnesus; and in the north-west, along the shores of Elis, are considerable tracts of alluvium. Volcanic rocks are not seen on the mainland, but form considerable masses in some of the islands. Attica was rich in silver and marble.

Divisions.—On the north-west of the mainland of Greece was the mountainous region of Epirus, and to the east of that district, separated from it by the chain of Pindus, lay Thessaly. Neither of these divisions contained any towns of importance. To the south lay a series of small independent states. Reckoned from west to east, there were Acarnania, Ætolia, Doris and Locris, Phocis with Mount Parnassus, the seat of the Muses, and the sacred Delphi, regarded by the Greeks as the navel of the earth; Bœotia, with Helicon, another mountain sacred to the Muses, and with the cities of Thebes and Platææ; Megaris, containing the city of Megara; and Attica with its capital Athens, Piræus, the port of Athens, and the city of Eleusis, the seat of the mysterious worship of Demeter. In the middle of the Peloponnesus was Arcadia, with the towns of Mantinea, Tegea, and Megalopolis, the last founded by the advice of Epaminondas at a comparatively late epoch in Greek history. In the north lay Sicyon and Corinth, the latter situated on the isthmus connecting the Peloponnesus with the rest of Greece; and to the west of that Achaia. To the south-west of Achaia lay the rich province of Elis, with the plain and sacred grove of Olympia, celebrated on account of the Olympic games, which were held here every fourth year. To the south of Elis, in the south-west corner of the Peloponnesus, lay the province of Messenia, with the famous stronghold of Ithome, 'one of the horns of the Peloponnesus', the fort of Pylos, and later the town of Messene, founded by the advice of Epaminondas. Separated from Messenia by the range of Taygetus was the province of Laconia, occupying the south-east corner of the Peloponnesus, and containing the renowned city of Sparta, long the rival and ultimately the conqueror of Athens. Lastly, to the north of Laconia, the east of Arcadia, and the south of Sicyon, lay the province of Argolis, with the capital Argos, and the cities of Mycenæ and Tiryns, all remarkable for the remains of gigantic works of masonry, commonly known as Cyclopean works.

The islands of Greece are partly scattered over the Ægean Sea and partly contained in the Ionian Sea on the south-west of the mainland. The Greeks applied the names Cyclades and Sporades to two groups of islands in the Ægean, the former name (from *kuklos*, a circle) to those which they believed to form a circle round the sacred island of Delos, and the latter (from *speiro*, I scatter) to those which were scattered over various parts of the sea. These designations were not used with any great degree of precision. Some islands were sometimes said to be in the one group and sometimes in the other, and several were sometimes excluded from both. The following, however, are the principal of those which may most properly be considered as belonging to the Cyclades: —Andros, Tenos, Myconos, Naxos (now Naxia), Paros (celebrated for its marble), Amorgos, Anaphe, Thera (now Santorin), Pholegandros (now Polykandro), Sicinos, Ios (now Nio), Melos, Syros, and Gyaros (Jura), besides the four already mentioned, Siphnos, Seriphos, Cythnos, and Ceos. The name Sporades may be applied to all the other islands in the Ægean. The Sporades will thus include the following islands on the north-east of the mainland of Greece:—Eubœa (Negropont), the largest of all the Greek islands, separated from the continent only by the narrow strait of Euripus, and containing the ports of Chalcis and Eretria; Sciathos, Scopelos, Halonesus (Kilidromi), Eudemia (Sarakino), and Scyros; the following off the coasts of Thrace and Asia Minor:—Lemnos, Thasos, Imbros, and Samothrace (in very remote times the seats of a mysterious religious worship), Lesbos (with the flourishing and luxurious town of Mitylene), Chios, Samos, Cos, &c.; and the following in the Saronic Gulf, or between it and the Argolic Gulf:—Salamis (now Salamis or Koluri), Ægina, Calauria (Poros), Hydrea (Hydra), and Tiparenus (Spezzia). The islands in the Ionian Sea are Corcyra (Corfu), celebrated in the most ancient times for its wealth and culture, and at a later period colonized by Corinthians; Paxos, Leucas or Leucadia (Santa Maura), at one time connected with the mainland; the 'rocky' Ithaca (now vulgarly called Thiaki), the home of Ulysses; Cephallenia (Cephalonia), Zacynthus (Zante), and Cythera (Cerigo), one of the seats of the worship of the goddess Aphrodite.

Soil, Productions, &c.—Greece was in ancient times more fertile than it is now, which is accounted for by the fact that the forests have been to a large extent cleared away, and the springs thus dried up, and the soil deprived of moisture. The most fertile districts were Thessaly, Bœotia, and some parts of the Peloponnesus; the least fertile Attica and Arcadia. The principal objects of cultivation were the vine and the olive, but flax and the commoner cereals were also cultivated more or less. Among the domestic animals were horses, asses, mules, oxen, swine, sheep, goats, and dogs. Swine were very numerous everywhere, and mules were much used in the Peloponnesus; but there were comparatively few horses, as the mountainous character of the country was not conducive to their being reared: the best horses of Greece were reared in Thessaly. Bears, boars, and wolves are mentioned among the wild animals anciently found in Greece, and it may perhaps be inferred from the legend of the Nemean lion that even lions at one time existed in this country. Herodotus, indeed, expressly states that lions were found between the Nestus in Thrace and the Achelous in Acarnania.

Climate.—The climate of ancient Greece is highly commended by ancient Greek writers, as by Herodotus, Hippocrates, and Aristotle, on which account it seems fair to infer that the malaria which now infests the air in summer did not then prevail to the same extent, a circumstance that is easily accounted for by the fact that in those times the country was more thickly populated and better cultivated. In respect of temperature the same differences resulting from the inequalities of the surface must have existed then as exist now, long and severe winters being

experienced in the highlands of the interior, while the lowlands, exposed to the sea, enjoyed warm and genial weather all the year round.

History.—The territory to which we have confined the name of Greece has never at any period formed a single and independent state. As long as it remained independent it was divided into a number of separate states, and during the only period when it was administered as a single territory it was subject to a foreign power. A general sketch of the history of ancient Greece like the present must therefore, for brevity's sake, avoid as much as possible going into details of the history of the several states, referring for information on that subject to the special articles, and must touch only upon those leading events which belong to the common history of the Greek states, or which at least affected the Greek people as a whole, even although they may belong more especially to the history of an individual state.

The earliest inhabitants of Greece of whom anything is known are called by Greek writers Pelasgians. The ethnological affinities of these have often been discussed, but the most recent authorities believe that they were a non-Aryan people, occupying not only Greece, but the islands and eastern shores of the Ægean, and corresponding to the Iberians of Spain and Gaul, the Ligurians of North Italy, and probably to the modern Berbers of northern Africa. Recent archæological discoveries, the result of the researches and excavations of Schliemann and later investigators, have proved that even as early as the third millennium B.C. they had developed a civilization of really advanced character, carried on an active trade by sea, and had commercial relations extending as far as the Danube and the Nile. At first we find them using only implements of stone, later they passed into their bronze and iron ages successively. Relics of these first inhabitants of Greece are still to be seen in the remains of ancient buildings, especially in the so-called Cyclopean works in the Peloponnesus, where the ancient ruins of Tiryns and Mycenæ in particular have yielded remains that shed a most instructive light upon the primitive civilization of Greece. The early relations of Greece with the East are perhaps reflected in the legends of oriental colonists — Cadmus, Pelops, Cecrops, &c. — who settled in Greece in very remote times. At any rate the reality of an early connection between Greece and the East is established by the fact that the Greeks derived the greater part of their alphabet from the Phœnicians.

The Hellenes, or Greeks properly so called, entering the country probably from the north-west, subdued and partly displaced the Pelasgians. They are usually represented as having been divided into four chief tribes—the Æolians, occupying the northern parts of Greece (Thessaly, Bœotia, &c.); the Dorians, occupying originally only the small region in the neighbourhood of Mount Œta; the Achæans, occupying the greater part of the Peloponnesus; and the Ionians, occupying the northern strip of the Peloponnesus and Attica. The middle part of the Peloponnesus was still mainly inhabited by a Pelasgic population. The warlike and enterprising character of these Hellenic invaders is evidenced by the poetic legends of their achievements in the heroic ages, such as the tale of the Trojan War, of Theseus, of Jason and the Argonauts, &c. From all these we may gather at least that the Hellenes early distinguished themselves by building towns, making long voyages, planting distant settlements, and carrying on foreign wars. As in later times, they were divided into numerous states, each consisting of a single city with the surrounding territory. These states were governed by kings who were the heads of the supreme families, and who traced their descent from Zeus. By the side of the kings stood the heads of the other leading families of the state, who in Homer are also called kings, and likewise boasted of a descent from Zeus. In the public market-place (agora), where all the affairs of the state were transacted, these subordinate kings gave their opinions on every subject of deliberation, and advised the supreme ruler as to the course he should pursue, but beyond that they had no authority. Their influence, however, was very great, especially where the rightful head of the state did not possess the abilities of a ruler.

The distribution of the Hellenic tribes which we have just indicated is not that which continued throughout the main period of Greek history. It was entirely altered by an event called the Dorian migration, or sometimes the return of the Heracleids, which is placed by Thucydides about eighty years after the fall of Troy, and thus about the year B.C. 1104, according to the ordinary system of chronology. Before the great migration several smaller ones had taken place. One tribe, finding its territory too circumscribed, would move to another, expelling the inhabitants already settled there, who thus found themselves compelled to remove to some other district, where they treated the original inhabitants in the same way that they had been treated themselves. In this way there arose a general disturbance, till at last the hardy Dorian inhabitants of the mountainous region about Mount Œta began a migration on a greater scale than had hitherto been attempted, and thus brought about a series of changes which resulted in an entirely new settlement of the Greek territory. They first conquered a large part of northern Greece, and then entered and subdued the greater part of the Peloponnesus, driving out or subjugating the Achæans, as the Achæans had driven out or subjugated the Pelasgians. The Dorians are also said to have invaded Attica, where, however, they were baffled, according to the legend, by the self-devotion of Codrus, the king of that territory. It is said that an oracle had pronounced that in this war whichever side lost its king would be victorious, on which account strict orders were given to the Dorian soldiers to spare the life of the king of the enemy. But Codrus disguised himself in the dress of a common herdsman, and rushing into the thickest of the fight met his death, on learning which the Dorians despaired of success and withdrew. In the legend in which this series of events has come down to us the Dorians are represented as having entered the Peloponnesus under Temenus, Cresphontes, and Aristodemus, three descendants of Heracles, who had come to recover the territory of which their ancestors had been unjustly deprived by Eurystheus. Hence the name of the Return of the Heracleids, which has been mentioned as sometimes given to this event.

The Achæan inhabitants of the Peloponnesus whom the Dorians found there had a threefold fate. One part of them sought for new homes, and turned their steps towards the part of the Peloponnesus occupied by the Ionians, whom they expelled, keeping for themselves their territory, which hence received the name of Achaia. Another part voluntarily submitted to the invaders, who imposed tribute upon them and excluded them from all share in the government; while a third part resisted to the last, and were in the end reduced to the condition of slavery. In Laconia the former received the name *Perioeci* (dwellers round), and the latter were called Helots.

The Ionians who were driven out of the Peloponnesus found at first a refuge among their kindred in Attica, but when this district did not suffice for all the inhabitants, old and new, large numbers of them

left it and founded Ionic colonies on several of the islands of the Ægean Sea and on the middle part of the coast of Asia Minor, where they built twelve cities, which formed an Ionic Confederacy. The principal of these were Ephesus and Miletus. About the same time as the Ionians are said to have colonized the middle part of the seaboard of Asia Minor, another body of Greeks, proceeding from Thessaly and Bœotia, are said to have founded the Æolian colonies on some of the northern islands of the Ægean, and on the northern part of the western coast of Asia Minor. The Æolic colonies of Asia Minor also formed a confederacy of twelve cities, but the number was afterwards reduced to eleven by the accession of Smyrna to the Ionic Confederacy. While Ionians and Æolians thus colonized the middle and northern islands of the Ægean and coasts of Asia, the southern islands and the southern part of the west coast of Asia Minor were in like manner colonized by Dorian settlers. The six Doric towns in Asia Minor, along with the island of Rhodes, formed a confederacy similar to the Ionic and Æolic ones.

At this point it may be opportune to give a short account of the further development of Greek colonization, in order that we may not be obliged to return to the subject again. In the course of time new Greek settlements were made on the coasts of the Hellespont, the Propontis (Sea of Marmora), and the Black Sea, partly by emigrants from colonies previously founded, and partly by those coming direct from the mother country. The most important of these were Byzantium (Constantinople), Sinope, Cerasus, and Trapezus (Trebizonde). Further, there were flourishing Greek colonies on the coasts of Thrace and Macedonia; for example, Abdera, Amphipolis, Olynthus, Potidæa, &c.; and the Greek colonies in Lower Italy were so numerous that the inhabitants of the interior spoke Greek, and the whole region received the name of Greater Greece. The most famous of the Greek colonies in this quarter were Tarentum, Sybaris, Croton, Cumæ, and Naples. The island of Sicily also came to a great extent into the hands of the Greeks, who founded on it or enlarged many towns. By far the largest, most powerful, and most highly cultured of the Greek colonies was the Corinthian colony of Syracuse, founded in the eighth century B.C. On the north coast of Africa the Greek colony of Cyrene rivalled in wealth and commerce the city of Carthage; and on the south coast of Gaul that of Massilia (Marseilles) presented a model of civilized government to the inhabitants of the surrounding districts. All these towns kept up a commerce in the products of the land in which they were planted, the environs were cultivated to the highest degree, and adorned for miles around with country-houses and gardens. They exerted a most important and beneficent influence on the manners of the neighbouring inhabitants, but in course of time degenerated when habits of luxury grew up with their increasing wealth. They preserved the customs and institutions of their mother city, which they regarded with filial reverence; but otherwise they were perfectly free and independent.

Although it was the case that, as has been stated, ancient Greece never formed a single state, the various Greek tribes nevertheless always looked upon themselves as one people, and classed all other nations under the general name of *Barbaroi* (foreigners), which, at least in later times, always implied something of contempt. There were four chief bonds of union between the Greek tribes. First and chiefly they had a common language, which, though it had considerable dialectic peculiarities when spoken by different tribes, was yet understood throughout every part of Greece and in all the Greek colonies. Secondly, they had common religious ideas and institutions, and especially in the oracle of Delphi they had a common religious sanctuary, which fostered in all the same religious feelings and observances, which was held by all the states in equal reverence, and was resorted to from all parts of Greece (and even from foreign countries), alike by communities and individuals, for advice in circumstances of difficulty, and not unfrequently for indications as to the future. Thirdly, there was a general assembly of the Greeks called the Amphictyonic League, in which the whole nation was represented by tribes (not by states), and the chief functions of which were to guard the interests of the sanctuary of Delphi, and to see that the wars between the separate states of Greece were not carried on in too merciless a manner. When any of the ordinances of the league were violated it was its duty to see that the violators were punished, and to intrust the infliction of the punishment to some one of its members. In spite of this, however, its ordinances were habitually violated without any steps whatever being taken on the part of the league to prevent or punish the offence. The fourth bond of union between the tribes of Greece consisted in the four great national festivals or games, the Olympian, Isthmian, Nemean, and Pythian, which were held at different intervals in four different parts of Greece, in which all Greeks, and none but Greeks, were allowed to participate, and which slaves were not allowed even to witness. At these games contests took place in foot-racing and chariot-racing, boxing, wrestling, and throwing with the quoit (or discus), and prizes were also awarded for works of art, poems, dramas, histories, &c. The prize was a simple wreath of olive or pine branches, or of parsley; but the honour of gaining such a prize was so great that it brought glory not only on the winner himself, but on his whole family and kindred, and even on the state to which he belonged. The victor was welcomed home by a triumphal procession, and his victory was celebrated in odes sung on the occasion, and sometimes composed by the leading poets of Greece, as by Simonides and Pindar. The Olympic games were the most celebrated of these festivals. They were held in the summer once every four years; the month in which they were held was considered as sacred, and during it no acts of hostility were allowed to take place between any of the Greek states. Originally, the only contest at these games was a foot-race, and so high was the honour of a victory in this race esteemed, that from that of Corœbus in 776 B.C. the whole of Greece reckoned the time. The year in which any event happened was styled the first, second, third, or fourth year of a certain Olympiad, the name given to the interval elapsing between each celebration. (For further information on all these subjects, see the separate articles.)

The various small states of Greece may be divided, according to the form of their constitution, into the two great classes of aristocratic and democratic. Sparta or Lacedæmon, the chief town of Laconia and of the Doric tribe, was the leading aristocratic state; and Athens, the capital of Attica and the chief town of the Ionic tribe, was the leading democratic state; and as a rule all the Doric states, and subsequently all those under the influence of Sparta, resembled that city in their constitution; and all the Ionic states, and those under the influence of Athens, resembled it. These two tribes or races are the only ones that come into prominence during the earlier part of Greek history subsequent to the Doric migration. Sparta is said to have derived its form of government, and all its institutions, in the ninth century B.C., from Lycurgus, who made minute regulations as to the

whole course of education and the mode of life among the Spartans. All these regulations had but one object, that of training the Spartan youth for war, and developing a hardy and warlike spirit among the people generally. The immediate results of this mode of training were seen in the conquests which the Spartans effected over the surrounding states, especially over the Messenians in the eight and seventh centuries B.C. Many of the Messenians, after the disastrous termination of the second war, left their native country and founded the city of Messana in Sicily. Those who remained were reduced to the condition of Helots.

The constitution of Athens was not originally democratical. The legends of Theseus and Codrus make it pretty certain that it was at first monarchical. Afterwards it became aristocratic, and first received a more or less democratic constitution from Solon at the beginning of the sixth century B.C. This was followed about fifty years later by a monarchical usurpation under the celebrated 'tyrant' Pisistratus, and his sons Hippias and Hipparchus, the last survivor of whom, Hippias, reigned in Athens till 510 B.C. Hipparchus had been assassinated four years before in revenge for an insult offered to the sister of one of the conspirators; and the last four years of the reign of Hippias were distinguished by violence and cruelty, by which he estranged from him those by whose favour he had been enabled to maintain himself in his usurpation. This afforded an opportunity to his enemies to drive him from Athens, after which the republic was restored in a more purely democratic form than at first. These facts are mentioned because they had some effect in bringing on an event perhaps the most important in the common history of Greece during its most flourishing period.

Hippias, on being compelled to flee from Athens, found refuge at the court of the King of Persia, with whose aid he hoped to be able to return and rule once more in Athens. The Persian monarchy had been established about thirty or forty years before by Cyrus the Great, and its sway, at the time of which we are now speaking, extended not only over the whole of Persia, Media, and Babylonia, but also over Egypt and Asia Minor. With the rest of this last-mentioned territory the Greek colonies on the coast had been brought under the yoke of this extensive empire, and although, accustomed to freedom, they chafed under the foreign dominion, they were nevertheless kept in subjection by the native princes or tyrants whom the Persian monarch imposed on them as governors. One of the most powerful of these governors was Histiæus of Miletus, whose behaviour appears to have excited the distrust of Darius, the Persian king, for the latter, on the pretence of rewarding him for a signal service which he had previously rendered him, invited him to his court and kept him there in splendid captivity. To rid himself of this restraint Histiæus secretly incited his relative, Aristagoras of Miletus, to get up a rising among the Greek colonies of Asia Minor, in the hope that he might, during the disturbance, find an opportunity of returning to his home. The endeavours of Aristagoras were successful; all the Greek towns on the coast were soon in arms, and assistance was asked from the mother country. Only Athens, which feared lest Darius should re-establish Histiæus, and the small town of Eretria in Eubœa, furnished any aid. At first the rising prospered. The Greeks, in 496 B.C., conquered and burned the town of Sardes, the capital of Asia Minor, whereupon the rebellion extended over the whole of Ionia. But fortune soon changed. The superior forces of the enemy, and the want of union among the insurgents, led in the following year (495) to the loss of a naval battle, and soon after to the destruction of Miletus, the inhabitants of which were partly put to death and partly made captives.

Darius now determined to avenge himself on the Athenians and Eretrians for the part that they had taken in the rising. In 492 he sent out an expedition against them under his son-in-law Mardonius, but the fleet which carried his army was destroyed in a storm off the promontory of Mount Athos. Darius had at the same time despatched heralds to the islands and states of Greece to demand earth and water in token of submission. Most of the islands and many of the smaller states yielded, but Athens and Sparta indignantly refused the demand, and even went the length of putting the heralds to death. Enraged at this insult Darius equipped a second fleet for the subjugation of the refractory states, and placed it under the command of Datis and Artaphernes. But this met with no better fate than the first. The Persians indeed reached their destination, landed on the island of Eubœa, and after destroying Eretria, crossed the Euripus into Attica; but here they were met (B.C. 490) on the plain of Marathon by 10,000 Athenians and 1000 Platæans, under the great general Miltiades, and, although ten times as numerous, were totally defeated and pursued to their ships. This battle put an end to the second Persian expedition, but Darius did not, on that account, give up the purpose of vengeance which he had conceived. He at once began to make preparations for a third expedition, and this time on a far greater scale than before. In the midst of these preparations he died, leaving his plans to be carried out by his son Xerxes, who entered into them with such eagerness, that, according to popular tradition, he collected an army of 1,700,000 men and a fleet of 1200 large ships besides a number of smaller ones. Having crossed the Hellespont in 481 by means of two bridges of boats, he led his army through Thrace, Macedonia, and Thessaly, while his fleet followed the line of coast. Thessaly had surrendered without a stroke, and Xerxes at once pursued his march in the direction of Phocis. But before he could enter this territory he had to make his way through the narrow and difficult pass of Thermopylæ, which has been mentioned in the description of the physical features of Greece as terminating the chain of Œta on the east; and this had previously been occupied by 300 Spartans under Leonidas, along with several thousand allies. Here Xerxes for several days in succession in vain attempted with his mighty army to force a passage against what was in comparison a mere handful of Greeks; thousands of his troops were slain; and it was only after an infamous Greek, of the name of Ephialtes, had betrayed to the Persians a foot-path which led over the heights of Œta to the rear of the defenders of the pass, that the Persian king effected his purpose. On hearing of the approach of the Persians on the rear, Leonidas allowed all the allies to depart, while he himself and his 300 Spartans, along with 700 Thespians who voluntarily remained with them, held out until they were completely annihilated. This took place in B.C. 480.

The way through Phocis and Bœotia was now open to the Persians, who traversed these territories, advanced into Attica, and laid the city of Athens in ruins, putting to death the small garrison that had been left behind to defend the citadel. The women and children belonging to Athens had by this time, on the advice of Themistocles, been removed to Salamis, Ægina, and Trœzen, while all the men capable of bearing arms served in the fleet. It was to the genius and courage of Themistocles that the deliverance of Greece was now chiefly due. The united fleet of the Greeks had already contended

with success against that of the Persians off the promontory of Artemisium, and had then sailed into the Saronic Gulf, whither it was followed by the enemy. In this confined arm of the sea, where there was no room for the manœuvring of the numerous ships of the enemy, it was the design of Themistocles that a decisive battle between the two fleets should take place. To prevent his design from being frustrated by the plan of the Spartan Eurybiades, who had been intrusted with the command of the whole fleet, and who wished to sail out of the gulf and proceed to the Isthmus of Corinth, where he would have the support of the army, he secretly induced the Persians to make a sudden attack on the Greeks, in consequence of which a battle ensued with the result that Themistocles had anticipated, the total defeat of the Persians. This battle is known as the battle of Salamis, and was fought in the same year as Thermopylæ (B.C. 480).

From a neighbouring height Xerxes himself had been an eye-witness of the destruction of his fleet, and at once began a speedy retreat with his land army through Thessaly, Macedonia, and Thrace, a retreat which Themistocles had hastened by causing the false report to reach Xerxes, that it was the intention of the Greeks to destroy the bridges of boats over the Hellespont. Xerxes left behind him only 300,000 men in Thessaly. In the spring of the following year (479) these advanced into Attica and compelled the citizens once more to seek refuge in Salamis; but in the great battle of Platææ the Greeks, under the command of Pausanias, obtained so complete a victory, that only 40,000 of the Persians reached the Hellespont. On the same day the remnant of the Persian fleet was attacked and defeated by the Greeks off Mount Mycale on the Asiatic coast.

The third and last Persian invasion of Greece thus failed as completely as the other two. By the brilliant part which the Athenians under Themistocles had taken in repelling this invasion the city of Athens had greatly increased her influence throughout the rest of Greece; and this was further strengthened by the fact that the war against Persia, which still continued, was chiefly conducted by sea, where Athens was much more powerful than Sparta. From this date then begins the period of the leadership or *hegemony* of Athens in Greece, which continued to the close of the Peloponnesian war, 404 B.C. The first thing which Athens exerted her influence to effect was the formation of a confederacy including the Greek islands and maritime towns as well as Athens herself, the object of which was to supply means for the continuance of the war by the payment into a common treasury established on the island of Delos, of a fixed sum of money, and by furnishing a certain number of ships for the same purpose. In this confederacy Athens of course had the lead, and she gradually increased her power so much that she was able to render tributary many of the islands and several of the smaller maritime states. In 469 B.C. the series of victories won by the Athenians over the Persians was crowned by the double victory of Cimon, the son of Miltiades, over the fleet and army of the Persians on the river Eurymedon, in the south of Asia Minor; and this victory was followed by the honourable peace known as the Peace of Cimon, which secured the freedom and independence of all Greek towns and islands. Shortly after followed the brilliant administration of Pericles, during which Athens reached the height of her political grandeur, while at the same time she flourished in trade, in arts, in science, and in literature.

The position of Athens, however, soon raised up a number of enemies. Sparta regarded her prosperity with jealousy; and the arrogance and severity with which the Athenians treated the states which came under her power produced a pretty general feeling of indignation and hatred. In the course of time two hostile confederacies were formed in Greece, both of which regarded war as inevitable, although both hesitated to begin. At the head of one of these confederacies was the city of Athens, which was joined by all the democratic states of Greece, and more or less supported by the democratic party in every state. At the head of the other confederacy stood Sparta, which was similarly joined by all the aristocratic states, and supported by the aristocratic party everywhere. At last in 431 war was declared by Sparta on the complaint of Corinth that Athens had furnished assistance to the island of Corcyra in its war against the mother city; and on that of Megara, that the Megarean ships and merchandise were excluded from all the ports and markets of Attica; and thus began the Peloponnesian war which for twenty-seven years devastated Greece in the most terrible manner.

In the first part of the war the Spartans had considerable successes, which were aided by a great calamity which befell the Athenians. On the advice of Pericles the Athenians had collected all the inhabitants of the country districts of Attica within the walls of the city; and in consequence of the overcrowding thus produced a pestilence broke out which carried off thousands of the inhabitants, and, what added to the calamity, among them Pericles himself. From this blow, however, the city soon recovered, and in 425 the early successes of the Spartans in Attica were compensated by the capture of Pylos in Messenia by the Athenian general Demosthenes, who at the same time succeeded in shutting up 400 Spartans in the small island of Sphacteria, opposite Pylos, where they were ultimately starved into surrender. The person to whom the surrender was made was the demagogue Cleon, who, although no credit was due to him for the result, boasted of it as a great military feat, and in consequence obtained the command of an army which was sent to operate against the brave Spartan general Brasidas in Thrace. But in 422 he was defeated by Brasidas before the town of Amphipolis, and himself slain in the flight, after which the opposite party in Athens got the upper hand, and concluded the peace with Sparta known as the Peace of Nicias (421 B.C.)

The effect of this peace was to divide the Spartans and the Corinthians, who had hitherto been allies. The latter united themselves with Argos, Elis, and some of the Arcadian towns to wrest from Sparta the hegemony of the Peloponnesus. In this design they were supported by Alcibiades, a nephew of Pericles, a man of handsome figure and great personal accomplishments. The war which was now waged between Sparta on the one hand and Corinth and her allies on the other resulted, however, in favour of the former, whose arms were victorious at the battle of Mantinea in 418.

Soon after this the Athenians resumed hostilities, fitting out in 415 B.C. a magnificent army and fleet, which were placed under the command of Alcibiades, Nicias, and Lamachus, and were intended for the reduction of the Dorian city of Syracuse in Sicily. This undertaking, which renewed once more the hereditary hatred between Sparta and Athens, was, however, a complete failure. Alcibiades was accused in his absence by his enemies of several offences against religion and the constitution, and was therefore deprived of his command. Thirsting for revenge, he betook himself to Sparta, and exhorted the city to renew the war with Athens. By his advice one Spartan army was despatched to Attica, where it took up such a position as prevented the Athenians

from obtaining supplies from the island of Eubœa, while another was sent under Gylippus to assist their kindred in Sicily. These steps were ruinous to Athens. The brave Lamachus fell in the siege of Syracuse, and in the harbour of the city the Athenian fleet was totally destroyed. The reinforcements sent out from Athens under Nicias and Demosthenes were attacked and defeated (B.C. 413) by the combined Spartan and Syracusan armies. All the Athenians who escaped being slain in battle were made captives, and in accordance with the savage mode of warfare which prevailed in all these internecine contests among the Greeks were compelled to work as slaves in the quarries of Sicily, although it may be mentioned as an interesting fact, characteristic of the people among whom the war was carried on, that many of these captives, it is said, obtained their liberty by being able to recite fragments of Euripides.

When the news of this disaster reached Greece many of the allies of Athens fell away and joined the Spartans, who now pressed on the war with greater energy both by land and sea. In their distress the Athenians recalled Alcibiades, who returned in 407, and was received by his fellow-citizens with the warmest enthusiasm as their expected deliverer. A few months afterwards, however, he was again an exile, having been deprived of the command of the Athenian fleet because one of his subordinates had lost a naval battle fought off Ephesus in his absence. During the rest of the war the Athenians had only one gleam of hope. This consisted in the naval victory won off the islands of Arginusæ over the Spartan Callicratidas in 406. In the following year (405) the carelessness of the Athenian commander enabled the Spartans to make themselves masters of the whole of the Athenian fleet except nine vessels while the majority of the crews were on shore at Ægospotamos on the Hellespont. The Spartans now easily subdued the islands and states that still maintained their allegiance to the Athenians, after which they laid siege to the city of Athens itself. In 404 B.C. the war was terminated by the Athenians being starved into surrender. Following the usual policy of a triumphant state in Greece Sparta imposed upon Athens an aristocratic form of government, placing the supreme power in the hands of thirty individuals, who are commonly known as the Thirty Tyrants. Only a year later, however (403), Thrasybulus was able to overthrow this hated rule and re-establish the democracy.

The period which follows the fall of Athens is that of Sparta's leadership or hegemony in Greece, which lasted till the battle of Leuctra, in 371 B.C. The power that the Spartans now exercised was abused by them quite as much as the Athenians had abused theirs, and thus they as speedily roused the hatred and jealousy of the other states. The Greeks generally, or at least the members of those states which had up to this time been, and still continued to be, the leaders in Greece, had now lost almost entirely their former manliness and independent spirit, and the mutual rancour between the different states was now so great that they no longer had public spirit enough to maintain the hereditary war against Persia, but they each sought the aid of that power for their own purposes. The Spartans did indeed send an expedition under their king Agesilaus into Asia Minor, but it came to nothing; and the states of Greece, the Spartans included, at last, in 387, agreed to the disgraceful Peace of Antalcidas, by which the whole of the west coast of Asia Minor was ceded to the Persians, and the Greek colonies there thus deprived of the independence that had been secured to them by the Peace of Cimon.

An act of violence committed by a Spartan general in Thebes in 380, quite in the spirit of the usual behaviour of Sparta, was what in the end led to the complete downfall of that city. The aristocratic party in Thebes, when the Spartan army happened to be in the neighbourhood, prevailed upon the general to give his assistance in overthrowing their opponents and establishing an aristocratic government. The leaders of the democratic party were, as usual in such cases, partly executed and partly placed in confinement, while a number of the less prominent members made their escape to Athens, where they got the support and assistance of the democratic party there. Encouraged by this party they soon returned in disguise to their own city, where they surprised and murdered the leaders of the aristocratic party, expelled the Spartan garrison which had been left in the city, and again set up a democratic government. These circumstances are detailed here because, although they belong more to the history of Thebes than to that of Greece generally, they give a vivid idea of the fury of party strife which was then general in the Greek cities, and which recalls to mind the violence exhibited by the Guelf and Ghibelline parties in the cities of Northern Italy during the thirteenth and fourteenth centuries. The immediate result of this counter-revolution in Thebes was a war with Sparta, the heroes of which were Epaminondas and Pelopidas, two disinterested patriots who were then at the head of affairs in Thebes. In the course of the war the Spartans invaded Bœotia, but were so completely defeated at Leuctra in 371 B.C. that they never fully recovered from the blow.

With this victory Thebes won the leading place in Greece, which she maintained during the lifetime of Epaminondas, whose influence was paramount in the Peloponnesus. Here it was his policy to keep down the power of Sparta by strengthening the surrounding states. From him the Messenians recovered their freedom, and by his advice the cities of Arcadia formed themselves into a confederacy, and built on a large scale the city of Megalopolis, which was to be at its head. This policy was at first successful, but in a few years the confederacy which he himself had originated and fostered began itself to strive after the supremacy, and joined themselves with this object to the Spartans. Epaminondas then invaded the Peloponnesus to check their further efforts, but although the Thebans were again victorious, and totally defeated the Spartans and Arcadians in the battle of Mantinea in 362, yet the victory being won with the loss of their great general, the Thebans could no longer boast with justice of supremacy in Greece. Pelopidas had died two years before.

Two years after the death of Epaminondas Philip, the father of Alexander the Great, became king of Macedonia. He was a man of great ability as a soldier and a ruler, an admirer of the Greek character, and a lover of Greek art and literature. He perceived, however, the weakness of the Greeks, arising from their utter want of unity, and eagerly looked for an opportunity of interfering in the affairs of their country, with the view of ultimately making himself master of it. An occasion for interference was furnished him by the war known as the Sacred war (355–346). This war arose from the Phocians having taken possession of some of the land belonging to the sanctuary of Delphi. The Amphictyonic League condemned the Phocians for this to pay a fine and restore the land they had taken, and when this was refused the league imposed upon the Thebans the task of forcing the Phocians to submit to the demands of the league. The latter, however, in their rocky strongholds were able to resist all the efforts of their assailants, who at last called in the aid of Philip of

Macedon. With his help the Phocians were subdued, when their towns were razed to the ground, and they themselves expelled from the league, and their place given to Philip.

It was not, however, till the Locrian war (339–338) that Philip acquired a firm hold in Greece. The Locrians had committed the same offence as that of which the Phocians had been guilty, and when they likewise refused to pay the fine that was for this reason imposed upon them by the league Philip, as one of the members, received the charge of punishing them for their disobedience. The advance of Philip was at first witnessed with comparative indifference by the other states of Greece, but when his real designs became apparent the Athenians, on the advice of their great orator Demosthenes, hastily concluded an alliance with the Thebans, and an army was sent out to oppose him. The battle of Chæronea which ensued (338) turned out, however, disastrously for the Greeks, who saw their whole country laid at the feet of Philip. But the conqueror treated his new subjects with mildness, wishing to reconcile them to the Macedonian yoke, and being anxious also to win their favour before setting out on a new enterprise which he then contemplated, and which he hoped to carry out with their co-operation. This enterprise was the invasion and conquest of the rotten Empire of Persia, for which purpose he immediately set about collecting a large army, of which he got himself declared commander-in-chief by the Amphictyonic League in an assembly held at Corinth in 337 B.C.; but before he was able to start he was assassinated, B.C. 336.

The design of Philip was taken up and carried out by his son Alexander the Great, during whose absence Antipater was left behind as governor of Macedonia and Greece. Greatly as the Greeks had degenerated since the time of the Persian wars, they were yet far from willing to give up their freedom without a struggle, with whatever degree of mildness they might be treated by their conqueror, and however much he might hold them in esteem; and accordingly, soon after the departure of Alexander, Agis III. of Sparta headed a rising against Antipater. He was defeated, however, in the battle of Megalopolis in 330 B.C., and no other attempt was made by the Greeks to recover their liberty for nearly a hundred years. At the close of the wars which followed the death of Alexander, and which resulted in the division of his empire, Greece remained with Macedonia.

The last efforts of the Greeks to recover their independence proceeded from a tribe which had not come into prominence since the heroic ages, namely, the Achæans in the northern strip of the Peloponnesus. This tribe is frequently mentioned by Homer as taking a very prominent part in the Trojan war; but during the historical period of Greece they for the most part kept aloof from the quarrels of the other states, and did not even furnish assistance to their brethren in repelling the Persian invasion. They had taken part, though reluctantly, in the Peloponnesian war on the side of Sparta, and had shared in the defeat of Megalopolis in B.C. 330. In the course of the first half of the third century B.C. several of the Achæan towns expelled the Macedonians, and revived an ancient confederacy, which was now known as the Achæan League. About the middle of this century the league was joined by the town of Sicyon, the native city of Aratus, who soon after became its leading spirit. Through his influence it was joined also by Corinth, and then it began to aim at acquiring the supremacy throughout the Peloponnesus, and even throughout the whole of Greece, as well as at delivering Greece from the Macedonian yoke. In following out the first of these aims Aratus and the league came into collision with Sparta, which at that time happened to be governed in near succession by two kings, Agis IV. (244–240) and Cleomenes (236–220), who had both something of the old Lycurgan spirit in them, and who desired to restore the Spartans to their former simplicity of manners and warlike disposition, and to raise them once more to their former political greatness. These, then, naturally looked with jealousy on the efforts of Aratus, and during the reign of Cleomenes a war broke out between Sparta and the Achæan League. The league was at first worsted, and was only finally successful when Aratus, forgetting the ultimate end of his efforts in the pursuit of that which he had more immediately in view, called in the aid of the Macedonians. In the battle of Sellasia, in 222 B.C., Cleomenes was defeated and compelled to take to flight, and the Macedonians became masters of Sparta. Aratus died in 213, and his place was taken by Philopœmen, 'the last of the Greeks,' who roused the league once more to vigorous efforts, and gradually succeeded in making it in some degree independent of Macedonia.

About this time the Romans, whose power had been advancing meanwhile with rapid strides in Italy, and who had just come out victorious from a second war with Carthage, in which they had had to contend with Hannibal, one of the greatest military geniuses whether in ancient or modern times, found an occasion to interfere in the affairs of Greece. Philip V. of Macedon had allied himself during this war with Hannibal, and accordingly, as soon as the war was concluded, the Romans sent over Flamininus to punish him for so doing, and in this war with Philip the Romans were joined by the Achæan League. Philip was defeated at the battle of Cynoscephalæ in 197 B.C., and was in consequence obliged to agree to a peace, in which he recognized the independence of Greece. To gratify the Greek vanity Flamininus proclaimed the deliverance of Greece from the Macedonian yoke at a celebration of the Isthmian games in 196 B.C., but the Greeks soon felt that they had only exchanged masters, that they were in reality, although not in name, as much in subjection to them as they had ever been to the Macedonians. On this account the Ætolians, who had formed a league similar to that of the Achæans, appealed for assistance against the Romans to Antiochus the Great, king of Syria, one of the kingdoms which had been formed out of the empire of Alexander. The appeal was listened to; but the help afforded was useless, for Antiochus was defeated in a bloody battle at Magnesia in Asia Minor in 190 B.C. The Ætolians were compelled to pay a money indemnity, and to sacrifice some of their art treasures.

By this time the Achæan League was unquestionably supreme over all other powers within Greece, having been joined by all the states of the Peloponnesus. But the league itself was in reality subject to Rome, the senate of which assumed the right of regulating its proceedings; and on one occasion, in 168 B.C., on the conclusion of a war waged by the Romans against Macedonia, the former carried off into Italy 1000 of the noblest Achæans, on the pretext that they had furnished assistance to the Macedonians. Such was the posture of affairs until 147 B.C., when the league openly resisted a demand made by the Roman senate, that Sparta, Corinth, Argos, and other cities, should be separated from it, in consequence of which a war ensued, which was concluded in 146 B.C. by the capture of Corinth by the rude consul Mummius. It is generally stated that Greece was immediately erected into a Roman province with the name of Achaia, including probably

the whole of Greece, except Epirus; but there are several circumstances that seem to render this doubtful, and the fact that the first governor of the province of whom any mention is known to have been made by classical writers, Servius Sulpicius, was appointed by Julius Cæsar makes it not improbable that it was Cæsar who first formed the province. However this may be, the independence of Greece was virtually gone with the fall of Corinth. From this date the prosperity of the cities of Greece rapidly declined, and the last sparks of the ancient Greek patriotism and love of independence became extinguished. The various cities still retained, however, something of the qualities for which they had been remarkable at the height of their glory. Athens was still one of the great centres of culture, and the cradle of all kinds of new speculations—the Athenians, as St. Paul says, and the strangers in Athens, 'spent their time in nothing else, but either to tell, or to hear some new thing.' Many left their native city and made a livelihood, although they gained little esteem, among the Romans, as artists and scholars, actors and dancers, poets and wits. The citizens of Sparta continued to gratify their thirst for warfare by serving as mercenaries in foreign armies. Corinth was still the home of luxury and vice.

From the date above-mentioned Greece remained attached to the Roman Empire. On the division of the Roman Empire it fell of course to the eastern or Byzantine half. From 1204 to 1261 it formed a part of the Latin Empire of the East, and was divided into a number of feudal principalities. In the latter year it was re-annexed to the Byzantine Empire, with which it remained till it was conquered by the Turks between 1460 and 1473. In 1699 the Morea was ceded to the Venetians, but was recovered by the Turks in 1715. For the history of the present Kingdom of Greece, see GREECE (MODERN).

The history of ancient Greece has been written by various eminent scholars, Thirlwall and Grote being standard authorities, whose works appeared respectively in 1839–44 and 1846–50. Among more recent works are those by Abbott (1888–92, 2 vols.), Curtius (English translation 1868–73, 5 vols.), Holm (do., 1894–98, 4 vols.). An excellent manual, giving recent results, is that of Professor Bury (1900).

Cosmogony and Religion.—Nowhere did polytheism develop itself into a brighter and more beautiful system than amongst the ancient Greeks. It was this circumstance no doubt that led the Romans, when they became acquainted with the literature and religion of the Greeks, to adopt their whole religious system and blend it with that of the ancient Italians, identifying the Greek deities with those of their own pantheon. In this way the Greek and Italian deities came to be confounded together, and the names of the latter even came to supersede those of the former, and on this account it will be of service in giving an account of the Greek polytheism to add in brackets to the names of the gods of the Greeks the names of the Italian gods with whom they ultimately became confounded.

According to the view of the origin of all things which in course of time grew up among the Greeks, the universe was in the beginning a formless mass, Chaos (confusion), from which arose the 'broad-bosomed' Earth (Greek, *Gaia, Gē;* Latin, *Tellus*), the Lower World (Tartarus), the darkness of Night (Greek, *Nux;* Latin, *Nox*), the parent of Light, and the formative principle of Love (Greek, *Erōs;* Latin, *Amor*), all of which were regarded as independent divinities. From the womb of the Earth proceeded the Heaven (Greek, *Ouranos;* Latin, *Cœlus*) and the Ocean, and afterwards the Titans, creatures of superhuman size and strength, who formed the first dynasty of gods. The Titans were succeeded by a more genial race of divinities endowed with intellectual as well as physical qualities, who subdued the Titans, and subsequently the Giants, another race whom the Earth produced after the loss of her first brood. In this second dynasty of gods the supreme ruler was Zeus (Jupiter or Juppiter), the son of Kronos (Saturn), who after the subjugation of the Titans and Giants ruled in Olympus over 'the middle air,' while his brother Pluto reigned over the dark kingdom of the lower world (Hades, Tartarus, Orcus), and Poseidōn (Neptune), armed with his trident, ruled in the sea. Like reverence was paid to Hēra (Juno), the sister and wife of Zeus, and the queen of Heaven, the virgin Pallas Athēnē (Minerva), a goddess armed with helmet and shield, and worshipped as the patroness of all intellectual employments and useful inventions, to the two children of Lētō (Latona), Apollo, the leader of the Muses (hence called Musagetēs) and the protector of the fine arts, and his sister the chaste huntress Artemis (Diana), the goddess of the moon, to the beautiful daughter of Zeus Aphroditē (Venus), the goddess of love, Ares (Mars), the god of war, Hermes (Mercury), the herald of the gods, and others besides. In addition to these there was an innumerable host of inferior deities (Nymphs, Nereids, Tritons, Horai, Sirens, Dryads and Hamadryads, &c.) who presided over woods and mountains, fields and meadows, rivers and lakes, the seasons, &c. There was also a race of heroes or demigods (Heracles or Hercules, Perseus, &c.) tracing their origin from Zeus, and forming a connecting link between gods and men, while on the other hand the Satyrs formed a connecting link between the race of men and the lower animals. According to a plausible theory, now less generally held than formerly, these gods and demigods are nothing else than the personified objects of nature (the Sky or Upper Air, the Sun, the Ocean, the Air in Motion, &c.), and were originally not conceived as personified, in the strict sense of the term, that is, as clothed in a human form, but simply as the objects themselves, to which the earliest races everywhere attributed a conscious existence like their own, and that the mythological tales relating to these deities and heroes were in their simplest form the natural expression of what human beings in their infancy believed to be done and felt by the very things which they saw. If anything happened to any object they never dreamed of anything else than that object felt what had taken place, and therefore expressed themselves in such a manner as to indicate that belief. If any change took place by the action of one object on another (as when the sun dries up the dew), the former was conceived as consciously acting, and the latter as consciously suffering; the sun in the case supposed was said to kill the dew, and when the original simple belief on which that expression was based was lost, the sun was thought of as a person called Kephalos, and the dew as one called Prokris, and the original phrase came to express a different thing, namely, that Kephalos killed Prokris, that is, that one person killed another. Such is the theory of Max Müller, Mr. Cox, and others; but it will be more appropriately expounded in the article MYTHOLOGY.

With regard to the inculcation of religious beliefs, and the practice of religious duties among the Greeks, the most striking thing to remember is that they had no separate class appointed to perform these functions. The priests were in no sense preachers of doctrines, but merely hierophants, or exhibitors of sacred things, of rites, symbols, and images. They showed how the gods were to be worshipped, or more usually how a particular god was to be worshipped; but it was not their office to teach theological doctrine, or

even as a rule to exhort to religious duty. The true teachers of the Greek religion were the poets and other writers, and it is to the hymns, epics, dramas, and histories of the Greeks that we must turn in order to learn how they regarded the gods. From this circumstance it results that it is impossible to give a consistent account of the Greek faith, since the different writers are not consistent with each other, each of them, while accepting the common foundations of the popular faith, expressing his own views with regard to the attributes of the gods. Thus we find in some more exalted views than in others, and very frequently also we find that the author is not consistent with himself, expressing in one passage an opinion of his own far above any to which the popular mind had reached, and in another passage expressing, without appearing to see the inconsistency, some one of the popular beliefs in direct contradiction to the former. There thus appears a great amount of vacillation in the representations of the gods found in Greek writers, both in respect of what may be called their ontological attributes and their moral attributes. In many places it is stated that the gods live an easy and serene life without physical pain, and free from every care. On the other hand, the god Prometheus is represented as being doomed to eternal torment by Zeus for an offence he had committed against the other gods. Ares is described in Homer as being wounded in battle and crying out with pain with a shout like that of ten thousand men, and Zeus himself is represented as being pained at the loss of a favourite in battle. The gods are again described in many passages as eternal and immortal; Homer speaks of them frequently as those who were, and are, and are to be. Yet in opposition to this we have seen that another race of gods are supposed to have preceded the dynasty of Zeus, and that these passed away, and that Zeus himself and all the other gods were represented as being born, a circumstance which readily suggested that they might also die. The gods are also stated again and again to be omnipotent; but it is not each of the gods to whom this attribute belongs, but all of them together. The power of each is limited by that of the others; and if omnipotence belongs to any one of them it is to Zeus alone; but even he is represented as subject to Fate. They are also represented as omnipresent and omniscient; but by the first of these attributes it was only meant that in every part of the universe there was a god—not that the universe was pervaded by the power of a single deity—and the second of these attributes is inconsistent with the representations elsewhere occurring of Zeus being in doubt as to what he should do, and even being duped by the artifices of others.

In the case of the moral attributes of the gods, that which is represented with most frequency and uniformity as belonging to them is the attribute of justice, so far at least as that is manifested in the punishment of the wicked. This the Greeks appear to have believed more firmly than anything else, that punishment would most certainly be inflicted by the gods for any offence committed against them. They were not at all disturbed in this belief by seeing men continue to prosper long after the commission of some great crime, for in such a case they said that the gods allowed them to prosper for a while merely in order that the punishment might fall upon them all the heavier in the end. Sometimes a man guilty of some offence would appear to escape punishment altogether, living in prosperity and happiness to the end of his life, but in this case the Greeks had two explanations. Either the punishment due to his crimes descended upon his children, or he was punished in a future state. The first view is frequently expressed in Greek writers, and a striking instance of the firmness with which it was held occurs in Herodotus, who records that when Xerxes, king of Persia, sent to the Spartans to demand of them earth and water in token of submission, the Spartans cast the heralds into a well, telling them to fetch earth and water thence. Upon this, he says, Talthybius, an ancient herald of Sparta, to whom a temple was erected in the city where he was worshipped as a hero, exhibited signs of anger, and nothing prospered with the Spartans after that, until they determined to send two of their noblest youth to Xerxes, that he might put them to death for the heralds that had been killed at Sparta. Xerxes, however, sent them back unhurt; but the gods, says Herodotus, were not appeased, for the sons of these nobles were afterwards captured in battle by the Athenians, who put them to death. The other view, that a person who had escaped punishment in this life would be punished in a future state is also found stated, but not with the same frequency. With regard to the rewards bestowed by the gods upon men for their piety, the statements in Greek writers are by no means so clear as those about the punishment of the wicked. It is, indeed, stated that the gods do bestow rewards upon men, and generally upon the good, but they are nearly as often given to personal favourites. The gods are also represented by the Greeks as holy and truthful, although they are in innumerable other passages described as themselves guilty of the grossest vices, and likewise as prompting men to sin, and deceiving them to their own destruction. In their general attitude towards men the gods appear as inspired by a feeling of envy or jealousy which has to be appeased. They are envious of human prosperity, and desirous to destroy it, and their anger is extended to those who bestow benefits upon them. This comes out on numberless occasions. It was for bestowing the gift of fire upon men that Prometheus was condemned to everlasting torment. In the story of the ring of Polycrates, tyrant of Samos, Amasis, king of Egypt, is related to have advised him, when he was at the height of his prosperity, to cast into the sea whatever he valued most, for if his prosperity continued unbounded the gods would surely bring some great calamity upon him. Again, in a story which Herodotus relates of a visit which Solon, the Athenian, paid to Crœsus, king of Lydia, when the latter showed Solon all his wealth Solon refused to pronounce him the happiest of mankind, for no one could be pronounced happy till he died: 'he knew,' he said, 'how jealous the gods are with regard to human affairs; that they bring many evils upon a man in the course of a life of seventy years; and often destroy utterly a man to whom they had granted prosperity.' Such then was the general feeling of the gods towards men according to the Greek view, and hence they had constantly to be appeased, and their favour won by sacrifices and offerings. Certain classes were, however, under the peculiar protection and favour of the gods, especially strangers and suppliants. Strangers in Greek states, owing to the fact that they were entirely withdrawn from the protection of the laws, had all the more need of the protection which religion granted them. Hence they came to be considered as the peculiar objects of care of Zeus, who, it was believed, would punish any injury inflicted upon them by any one trusting to the impunity allowed him by the laws.

Having thus treated of the views which the Greeks held as to the qualities or attributes of the gods, both ontological and moral, we have now to speak of the religious rites and observances of the Greeks. The Greeks believed that the gods communicated their will to men in various ways, but above all, by means

of oracles, the chief of which were that of Apollo at Delphi, that of Zeus at Dodona, and that of Amphiaraus between Potniæ and Thebes. On account of the general use of oracles other means of divination were not so much resorted to by the Greeks, although they were not entirely neglected. Among these other means was divination by birds, which were supposed to indicate the mind of the gods by the direction of the flight, their manner of feeding, &c. &c. Thunder and lightning was also thought to be a communication from the gods, as well as anything remarkable, such as the birth of a monster, the eruption of a volcano, an earthquake, or a pestilence. If any one sneezed it was likewise thought to be, if rightly interpreted, a communication of the will of the gods. Dreams were, perhaps, in this respect next in importance after oracles. The rites which were performed by the Greeks in order to secure the favour of the gods were sacrifice and prayer. For the performances of all sacrifices of importance the strictest regulations as to time, place, and manner were given, and it was believed that the gods would be offended unless these were rigorously obeyed. Hence we read of the Spartans, who were the most superstitious of the Greeks, breaking up an expedition on one occasion and returning home, because the time for the performance of a certain sacrifice had come round. Sacrifices of less importance were very frequent, and were always accompanied by prayers. At births and at deaths, in the morning and in the evening, before every meal and on every special occasion prayers and sacrifices were offered up. At meal times the sacrifice usually consisted of a part of the food that was eaten together with a libation of the wine that was drunk. Offerings were also made to the gods as an atonement for sin, but these were of avail only when the sin had been committed in ignorance, and had always to be accompanied by purificatory rites.

Finally, in connection with the religious beliefs of the Greeks something ought to be stated with regard to their views on a future state. The Greeks appear to have had at all times some belief in a future existence, but in the earliest times this belief was far from being clearly defined. Homer allows a future existence only to the heroes, and even in their case the existence after death is a shadowy existence, in every way inferior to that upon earth. When Ulysses visits the lower world and there meets Achilles, the latter is represented as saying to him that he would rather have the existence of a serf on the earth than the life which he lived in the lower world. Between the time of Homer and that of Sophocles and Æschylus a development is discernible in the views held as to a future state, for in both of these poets, although only the heroes are conceived as living after death, their second life is described as altogether happier than their first. The doctrine of the immortality of the soul was first fully taught by the Orphic mysteries. The other mysteries, Samothracian, Dionysian, and Eleusinian, are supposed to have had for one of their objects the imparting to the initiated of more cheerful views regarding a future life than those usually held by the Greeks, but there is no proof that they taught the doctrine in question.

People, Manners, &c.—The principal traits in the character of the ancient Greeks were simplicity and independence of spirit. The Greek was his own instructor, and if he learned anything from others he did it with freedom and without slavish imitation. Nature was his great model, and in his native land she displayed herself in all her charms. The Greek was manly and proud, active and enterprising, violent both in his hate and in his love. These features of the Grecian character had an important influence on the religion, politics, manners, and philosophy of the nation. The gods of Greece were not, like those of Asia, surrounded by a holy obscurity; they were human in their faults and virtues, but were placed far above mortals. They kept up an intercourse with men; good and evil came from their hands; all physical and moral endowments were their gift. The love of freedom among the Greeks sprang partly from their good fortune in having lived so long their own masters, partly from their natural high-spiritedness. It was this which made small armies invincible, and enabled them to repel overwhelming odds. The cultivation of their fruitful country, which, by the industry of the inhabitants, afforded nourishment to several millions, and the wealth of their colonies, prove the activity of the Greeks. Commerce, navigation, and manufactures flourished on all sides; knowledge of every sort was accumulated; the spirit of invention was busily at work; the Greeks learned to estimate the pleasures of society, but they also learned to love luxury. From these sources of activity sprang also a love of great actions and great enterprises, so many instances of which are furnished by Grecian history. Another striking trait of the Grecian character was a love of the beautiful, both physical and intellectual. This sense of the beautiful, awakened and developed by nature, created for itself an ideal of beauty, which served them, and has been transmitted to us, as a criterion for every work of art. A noble simplicity pervades everything which comes from them. It is this which has made the Greeks the instructors of all ages and nations.

Greek Language and Writing.—The language which we call Greek belongs, as is well known, to the Indo-European or Aryan family of tongues, being akin to the Sanskrit, Persian, Latin, Celtic, Slavonic, and Germanic languages, including of course English. Out of Greece it was spoken in a great part of Asia Minor, of the south of Italy and Sicily, and in other regions which were settled by Grecian colonies. From the great number of Hellenic tribes of the same race it was to be expected that there would be different dialects, the knowledge of which is the more necessary for becoming acquainted with the Greek language, since the writers of this nation have transmitted the peculiarities of the different dialects in the use of single letters, words, forms, terminations, and expressions, and that not merely to characterize more particularly an individual represented as speaking, but even when they speak in their own person. It is customary to distinguish three leading dialects, according to the three leading branches of the Greeks, the Æolic, the Doric, and the Ionic, to which was afterwards added the mixed Attic dialect; besides these there are several secondary dialects. Akin to the Ionic is the so-called Epic dialect, that in which the poems of Homer and Hesiod are written, and which was afterwards adopted by other epic writers. The Doric was hard and harsh; the Ionic was the softest. The Æolic was spoken on the north of the Isthmus of Corinth (except in Megara, Attica, and Doris), in the Æolian colonies of Asia Minor, and on some of the northern islands of the Ægean Sea. The Doric was spoken in the Peloponnesus, in the Doric Tetrapolis, in the Doric colonies of Asia Minor, of Lower Italy (Tarentum), of Sicily (Syracuse, Agrigentum), and most purely by the Messenians; the Ionic in the Ionian colonies of Asia Minor, and on the islands of the Archipelago; and the Attic in Attica. In each of these dialects there are celebrated authors. The Ionic dialect is found pure in some prose writers, especially Herodotus and Hippocrates. The Doric is used in the poems of Pindar, Theocritus, Bion, and Moschus. Little Doric prose remains, and that is mostly on mathematical or philosophical subjects. In

Æolic we have fragments of Alcæus and Sappho. After Athens had obtained the supremacy of Greece, and rendered itself the centre of all literary cultivation, the master-pieces of Æschylus, Sophocles, Euripides, Aristophanes, Thucydides, Xenophon, Plato, Aristotle, Isocrates, Demosthenes, &c., made the Attic the common dialect of literature. Grammarians afterwards distinguished the genuine Attic, as it exists in those masters, from the Attic of common life, calling the latter the *common Greek* or *Hellenic* dialect; and even the later Attic writers, posterior to the golden age of the literature, were designated *Hellenes* or *common Greeks*. In this latter class are Theophrastus, Apollodorus, Polybius, Plutarch, and others. Many of the later writers, however, wrote genuine Attic, as Lucian, Ælian, and Arrian. Except the dramatists, the poets by no means confined themselves to the Attic; the dramatists themselves assumed the Doric, to a certain degree, in their choruses, for the sake of giving them additional solemnity, because of the antique and venerable character of this dialect. Undoubtedly the Greek dialects were not, in the earliest times, so distinct from each other as they afterwards became; and on this subject we may quote the words of Prof. Bury (Hist. of Greece, chap. i.): 'There can be little doubt that the mixture of the Greeks with the native peoples had a decisive effect upon the differentiation of the Greek dialects. The dialects spoken by the first settlers in Thessaly, in Attica, in Arcadia, have some common characteristics which tempt us to mark them as a group, and distinguish them from another set of dialects spoken by Greek folks which were to appear somewhat later on the stage of history. We may conjecture that the first set of invaders spoke in their old home much the same idiom; that this was differently modified in Thessaly and Bœotia, in Attica and Argolis, and the various countries where they settled; and that many of the local peculiarities were developed in the mouths of the conquered learning the tongue of the conquerors.' It results that to have a thorough knowledge of the Greek language we must follow out historically as far as possible the course of its formation, extending our view over all the varied forms of the dialects—a labour which this language, so rich in classic models of every kind, so perfect, so flexible, so expressive, so sweet in its sound, so harmonious in its movements, and so philosophical in its grammatical forms and whole structure, merits, and richly rewards.

When the Greeks became acquainted with the art of writing we do not know. In Egypt hieroglyphics were used more than three thousand years before the Christian era, and the cuneiform writing of Assyria and Babylonia had a similar antiquity. In Crete writing was practised more than two thousand years before Christ, it is believed, and among the Asiatic Greeks it was probably introduced nine or ten centuries before Christ. According to the writer above quoted: 'Perhaps the earliest example of a Greek writing that we possess is on an Attic jar of the seventh century; it says the jar shall be the prize of the dancer who dances more gaily than all the others. But the lack of early inscriptions is what we should expect. The new art was used for ordinary and literary purposes long before it was employed for official records. It was the great gift, which the Semites, who themselves derived it from Egypt, gave to Europe.' According to the legend it was Cadmus the Phœnician who introduced the alphabet into Greece; and, as already mentioned, it is an undoubted fact that the most of the Greek letters are derived from the Phœnician ones. The Greek alphabet possesses the following twenty-four letters:—A, α (alpha), *a*; B, β (beta), *b*; Γ, γ (gamma) *g*; Δ, δ (delta), *d*; E, ε (epsilon), *ĕ*; Z, ζ (zeta), *z*; H, η (eta), *ē*; Θ, θ, ϑ (theta), *th*; I, ι (iota), *i*; K, κ (kappa), *k*; Λ, λ (lambda), *l*; M, μ (mu), *m*; N, ν (nu), *n*; Ξ, ξ (xi), *x*; O, ο (omicron, *i.e.* small *o*), *ŏ*; Π, π (pi), *p*; P, ρ (rho), *r*; Σ, σ, ς (sigma), *s*; T, τ (tau), *t*; Υ, υ (upsilon), *u*, commonly transliterated by *y*; Φ, φ (phi), *ph*; X, χ (chi), *ch* guttural (as in Scotch *loch*); Ψ, ψ (psi), *ps*; Ω, ω (omega, or great *o*), *ō*. There are also marks indicating accent, a rough and a smooth 'breathing', the former equivalent to *h* initial before a vowel; but no *j*, *v*, *w*, &c. The alphabet originally introduced into Greece is said to have consisted of but sixteen letters; four (Θ Ξ Φ X) are said to have been invented by Palamedes during the Trojan war, and four more (Z H Ψ Ω) by Simonides of Ceos. That the eight letters mentioned are more modern than the others is certain, partly from historical accounts, partly from the most ancient inscriptions. It remains to remark that the Greeks originally wrote from right to left, then *boustrophedon*, that is, alternately from right to left and left to right, and finally always from left to right.

Greek Literature.—The origin of Greek literature, that is, of the intellectual cultivation of the Greeks as contained in written works, is lost in an almost impenetrable obscurity. Though there existed in Greece, in earlier times, no actual literature, there probably was by no means a want of what we may not improperly call *literary cultivation*, if we free ourselves from the prejudice that a literature must of necessity be embodied in written alphabetical characters. The *first period* of Grecian cultivation, which extends to the movement known as the invasion of the Peloponnesus by the Heraclidæ and Dorians, and the great changes produced by it, and which we may designate by the name of the *Ante-Homeric period*, was no doubt utterly destitute of literature; but it may be questioned whether it was also destitute of all that culture which we are accustomed to call *literary*. The fables which are told of the intellectual achievements of this period may have a certain basis of truth. Among the promoters of literary cultivation in this time we must distinguish three classes:—1. Those of whom we have no writings, but who are mentioned as inventors of arts, poets, and sages: Amphion, Demodocus, Melampus, Olen, Phemius, and Prometheus. 2. Those to whom are falsely attributed works no longer extant: Abaris, Aristeas, Chiron, Epimenides, Eumolpus, Corinnus, Linus, and Palamedes. 3. Those to whom writings yet extant, which, however, were productions of later times, are attributed: Dares, Dictys, Horapollo, Musæus, Orpheus, and the authors of the Sibylline oracles. This is not the place to inquire whether any and how much of these writings is genuine. It is enough that the idea of such a forgery proves a belief in the existence of earlier productions. And how could the next period have been what it was without previous preparation? If we may thus infer what must have been in order that the succeeding period should be what it was, we learn also from the various traditions of the Ante-Homeric period that there existed in it institutions which, through the means of religion, poetry, oracles, and mysteries, had no small influence on the civilization of the nation and the promotion of culture; for the most part, indeed, in oriental forms, and perhaps of oriental origin; and that these institutions, generally of a priestly character, obtained principally in the northern parts of Greece, Thrace, and Macedonia. We must here remark that intellectual cultivation did not prosper at once in Greece, nor display itself simultaneously among all the tribes;

that the Greeks became Greeks only in the process of time, and some tribes made more rapid progress than others.

About eighty years after the Trojan war new commotions and a new migration began within the borders of Greece. A portion of the inhabitants emigrated from the mother country to the islands and to Asia Minor. This change was in the highest degree favourable to Grecian genius; for the new settlements, abounding in harbours, and destined by nature for commerce and industry, afforded them not only a more tranquil life, but also a wider field for refinement, and gave rise to new modes of life. The ancients ascribed to the colonies in Ionia and the rest of Asia Minor the character of luxury and voluptuousness. The blue sea, the pure sky, the balmy air, the beautiful prospects, the finest fruits, and most delicious vegetables in abundance, all the requisites of luxury, here united to nourish a soft sensuality. Poetry and philosophy, painting and statuary, here attained their highest perfection; but great and heroic deeds were oftener celebrated than performed. Near the scene of the first grand national enterprise of the Greeks—the Trojan war—it was not strange that the interest this event excited should be lively, and that it should take a powerful hold of the imagination. Poetry thus found a subject, in the treatment of which it necessarily assumed a character entirely distinct from that of the former period. Among all nations heroic poetry has flourished with the spirit of heroism. The heroes were here followed by the bards, and thus the epopee was formed. We therefore call this *second period* the *epic age* of the Greeks. The minstrel (*aoidos*) now appears separated from the priest, but highly honoured, particularly because the memory of the heroes lived in his verse; and poetry was the guardian of all the knowledge of preceding times, so long as traditions were not committed to writing. From its very nature the epopee must be historical, in an enlarged sense. Under such circumstances it is not strange that regular schools for poets were established; for the imagination of the first poet fired the imagination of others, and it was then, perhaps, believed that poetry must be learned like other arts—a belief to which the schools for priests, on which the schools for minstrels were probably modelled, contributed not a little. But they were minstrels in the strictest sense, for their traditions were sung, and the poet accompanied his verses on a stringed instrument. On every important occasion minstrels were present, who were regarded as standing under the immediate influence of the gods, especially of the muses, who were acquainted with the present, the past, and the future. The minstrel, with the seer, thus stood at the head of men. But among the many minstrels which this age undoubtedly possessed, Homer alone has survived, whose name has always been associated with the two great epic poems, the Iliad and Odyssey, although in modern times the theory first promulgated by Wolf in 1795, that neither of these poems is the work of one man, has been accepted either entirely or with modifications by many scholars, and many others who contend for the unity of each of the two poems are yet inclined to believe that they were not both composed by the same individual. The latter opinion is not of modern origin, but divided also the Homeric scholars of ancient times. Several hymns, and a mock heroic poem called the Batrachomyomachia, or the Battle of the Frogs and Mice, are also ascribed to Homer, but on altogether insufficient grounds. From him an Ionian school of minstrels takes its name—the *Homeridæ*—who probably constituted at first, at Chios, a distinct family of rhapsodists, and who preserved the old Homeric and epic style, the spirit and tone of the Homeric verse. Much that was attributed to Homer may reasonably be assigned to them. A certain class of the followers of Homer are known by the name of the Cyclic poets, who began, however, to deviate materially from the Ionian epos, the historical element predominating more and more over the poetical. By Cyclus we understand the whole circle of traditions and fables, and not merely the events of the Trojan war. Cyclic poetry comprehended the whole compass of mythology; and we may, therefore, divide it into: 1, a cosmogonical; 2, a genealogical; and 3, a heroic Cyclus; in the latter of which there are two separate periods: 1, that of the heroes before; and 2, that of those after, the expedition of the Argonauts. To the first class belong the battles of the Titans and giants; to the second, the theogonies and herogonies. To the first period of the third class belong the Europia, several Heracleia and Dionysiacs, several Thebaids, Argonautics, Theseids, Danaids, Amazonica, &c. In the second period the poetry generally related to the Trojan war. To this belonged the Nostoi, which treated of the return of the heroes from Troy. The earliest of these Cyclic poets appeared about the time of the first Olympiad. A history of the gradual formation of their poetry cannot be given, because we have only very general accounts respecting them. But what we do know justifies us in concluding that between these historic poets and the Ionian school of minstrelsy something intervened, making, as it were, the transition. And we actually find this in the *Bœotian-Ascrean* school, which arose in European Greece, it is said, in the eighth century B.C. It derived its name from Ascra in Bœotia, the residence of Hesiod, who stood at its head, and by whom poetry was probably conducted back again from Asia Minor (for he was originally of Cyme in Æolia) to Greece. His works also were at first preserved by rhapsodists. They were not arranged till a later period, when they were augmented by foreign additions; so that, in their present form, their authenticity is as doubtful as that of the poems ascribed to Homer. Of the sixteen works attributed to him there have come down to us the Theogony, the Shield of Hercules (the fragment of a larger poem), and Works and Days (a didactic work on agriculture), the Choice of Days, intermixed with moral and prudential maxims, &c. The works of Homer and Hesiod acquired a canonical importance among the Greeks, and constituted, in a certain degree, the foundation of youthful education.

In the *third period*, the age of lyric poetry, of apologues and philosophy, our knowledge of Greek history gradually acquires a greater certainty. About the beginning of the epoch of the Olympiads (776 B.C.) there ensued a true ebb and flood of constitutions among the small states of Greece. After numerous vicissitudes of power, during which the contending parties persecuted each other for a long time with mutual hatred, republics, with democratical constitutions, finally sprang up, which were in some measure united into one whole by national meetings at the sacred games. The spirit prevalent in such a time greatly favoured lyric poetry, which now became an art in Greece, and reached the summit of its perfection at the time of the invasion of the Persians. Next to the gods, who were celebrated at their festivals with hymns, their country, with its heroes, was the leading subject of this branch of poetry, on the character of which external circumstances seem to have exercised no slight influence. The mental energies of the nation were roused by the circumstances of the country; and the numerous wars and conflicts, patriotism, the love of freedom and the hatred of enemies and tyrants, gave birth to the heroic ode. Life, however, was at the same time viewed more on its dark side. Thence there was an intermingling of

more sensibility in the elegy, as well as, on the other side, a vigorous reaction, in which the spirit of ridicule gave rise to the iambus (satire). In everything there was a more powerful impulse towards meditation, investigation, and labour for the attainment of a desired condition. The golden age, the gift of the gods, was felt to have departed. Whatever man discovered in future was to be the fruit of his own efforts. This feeling showed that the age of manhood had arrived. Philosophy had become necessary, and attained continually a greater development. It first spoke in maxims and gnomes, in fables and in dogmatic precepts. Lyric poetry next gave utterance to the feelings excited by the pleasures of earth. Of those who gained a reputation in this way, as well as by the improvement of music and the invention of various forms of lyric poetry, history presents us the names of Archilochus of Paros, inventor of the iambus; Tyrtæus, author of war songs; Callinus of Ephesus, inventor of the elegiac measure (all of whom flourished about 700 B.C.); Terpander of Antissa, in Lesbos (fl. 675 B.C.); Simonides of Amorgos (fl. 664), the second of the three principal iambic poets of Greece; Alcman the Lydian, and Arion of Methymna, said by Herodotus to have invented the dithyrambus (both flourished about 630 B.C.); Sappho, Alcæus, and Erinna, all natives of Lesbos, the first two of Mitylene, and all of whom flourished about 610 B.C.; Mimnermus of Colophon (flourished from about 634 to 600 B.C.); Stesichorus of Himera (fl. 600); Ibycus of Rhegium (lived about 540 B.C. at the court of Polycrates of Samos); Anacreon of Teos (lived first at the court of Polycrates, afterwards at that of Hipparchus at Athens); Hipponax of Ephesus (fl. 540 to 520), the third great iambic poet; Lasus of Hermione (fl. 520); Simonides of Ceos (fl. 500); his contemporary, Timocreon of Rhodes; Corinna of Tanagra (fl. 490), the friend and instructress of Pindar (522–442). As gnomic writers, Theognis of Megara and Phocylides of Miletus deserve to be named (both of whom flourished about 540 B.C.); as a fabulist, Æsop (fl. 570 B.C.) In the order of time several belong to the following period, but are properly placed here, on account of their connection.

If we consider the philosophy of this age, we find it to have generally had a practical character. The philosophy of life must precede the philosophy of science. Philosophy must give lessons of wisdom, before it can furnish scientific systems. In this light must we consider the *seven wise men of Greece*, as they are called (whose names as usually given are Periander, Pittacus, Thales, Solon, Bias, Chilo, and Cleobulus); who acquired the name of wise from their mature experience and the practical wisdom resulting from it, their prudence and reflection, their skill in affairs of state, in business and the arts. They all flourished in the seventh and sixth centuries B.C. Their sayings are practical rules, originating in the commerce of life, and frequently only the expression of present feelings. But as knowledge is the foundation of science, further investigations resulted in theoretical philosophy. Thales was the founder of the Ionic philosophy. Here we stand on the most important point of the history of the literary development of Greece, where poetry ceases to contain everything worthy of knowledge, to be the only source of instruction. Hitherto she had discharged the office of history, philosophy, and religion. Whatever was to be transmitted to posterity, whatever practical wisdom and knowledge was to be imparted, whatever religious feelings were to be inspired, recourse was had to her measured strains, which, from their rhythmical character, left a deeper and stronger impression on the memory. Henceforth it was to be otherwise. Civil life was to have an important influence on language. The public transactions, in which the citizen took a part, compelled him to make the language of common life more suitable for public delivery. This and alphabetical writing, that had now become common in Greece with the introduction of the Egyptian papyrus, prepared the way for the formation of prose. All this had an essential influence on the condition of science. From epic poetry proceeded, by degrees, history. From the practical wisdom conveyed in verse proceeded an investigating philosophy. Our former singleness of view is thus lost. We must now necessarily turn our attention to different sides, and, in the rest of our sketch, follow out each branch separately. Everything tended to excite the spirit of inquiry, and a scientific activity was everywhere awakened. We may therefore call the *fourth period*, that now ensued, the *scientific period*. It reaches to the end of Greek literature, but is divided into several epochs, according to the different spirit which predominated, and the superiority which a particular branch acquired at different times.

The *fourth period* extends from Solon to Alexander (594–336 B.C.) In philosophy, a physico-speculative spirit was manifested; for philosophy originated immediately from religion, and all religion rests on the conception of the Divinity, which was not then distinguished from nature. Now, since the conception of religion contained nothing but poetical ideas of the origin of the principal phenomena of nature, that is, of the divinities, the most ancient philosophy was, of necessity, natural philosophy, in which the human mind sought to analyze more thoroughly the phenomena previously observed, to explain them more satisfactorily, and to comprehend them in one whole. From the want of sufficient experimental acquaintance with nature, it was to be expected that the imagination would frequently interfere in the work of the understanding and reason. From this cause, these philosophical inquiries are interwoven with poetical images. This was the form of the Ionic philosophy, whose author was Thales (about 636–546); of the Pythagorean or Italic, whose founder was Pythagoras (fl. 540–510), and the older and later Eleatic. To the Ionic school, which sought after a material origin to the world, belonged Pherecydes (fl. 544), Anaximander (610–547), Anaximenes (fl. 544–480), Anaxagoras (500–428), Diogenes of Apollonia and Archelaus (fl. 450). The principal disciples of the Pythagorean philosophy, the leading idea of which was that of harmony or proportion, were, in Italy, Philolaus (fl. 440), Timæus of Locri, Ocellus Lucanus, and Archytas (fl. 400). To the older Eleatic school, which held the idea of a pure existence, belonged Xenophanes (fl. 540–500), Parmenides (fl. 480): to the later, Zeno (fl. 460) and Melissus. The atomists, Leucippus (of uncertain date), Democritus of Abdera (fl. 460), and Diagoras (fl. 410), as well as Empedocles (fl. 444), the author of the idea of four eternal and unchangeable elements (fire, air, earth, and water), acted on by two eternal and opposite forces (love and hate), are connected with this school. On the other hand, Heraclitus (fl. 513) stands alone in his theory of the eternal flow of things.

Till near the end of the fifth century B.C. the philosophers and their scholars were dispersed through all the Greek cities. About this time Athens became their principal place of residence, which contributed not a little to breathe another spirit into philosophy, the Sophists becoming the teachers. Gorgias of Leontini in Sicily, who joined the Eleatics, Protagoras of Abdera, Hippias of Elis, and Prodicus of Ceos, are the most celebrated whose names have reached us. Their name designates them as men of science; and they were, in fact, the encyclopædists of their times, who collected the ideas and sentiments of the

former ages, and enriched them with their own. They were particularly distinguished in rhetoric and politics, two sciences so highly important in democratic forms of government; but, not contented with this, they also professed the natural sciences, mathematics, the theory of the fine arts, and philosophy. In the last it does not seem to have been their object to arrive at truth, but only to make a plausible argument; and for this end they necessarily made use of those specious dialectic devices still called, from them, *sophistries*, and sought to lead their opponents astray by various means. That this must needs be detrimental to true philosophy is evident. So much the more fortunate was it that in this very age Socrates (469–399) appeared, who was not only a strenuous antagonist of these Sophists, but opened a new career to philosophy itself. It has been justly said of him that he brought down philosophy from heaven to earth, for he gave it again a practical direction, differing, however, from the former, since the object was no longer merely to string together experiments, but philosophers began to investigate the nature and relations of man, the object and best regulation of life; and reflection was turned principally to psychology and morals, instead of physics and metaphysics. Socrates had many scholars, some of whom committed his ideas to writing in his manner—Cebes, Æschines, Xenophon; others, deviating more or less from his ideas and his manner, were founders of philosophical schools of their own. The four following schools proceeded from that of Socrates: 1, the Cyrenaic, whose founder was Aristippus of Cyrene (fl. 370); 2, the Megaric, under Euclid (fl. 399); 3, the Academic, whose founder was Plato (429–347); and 4, the Cynic, whose founder was Antisthenes. Plato was unquestionably the most comprehensive and splendid genius. With the philosophical knowledge of the former Greek philosophers he combined that of the Egyptian priests and the eloquence of the Sophists. A fondness for the supernatural, a delicate moral sense, a fine, acute, and profound understanding, reign in his productions, which are adorned with all the graces of expression, and are enlivened by a rich imagination. By his poetic talent the philosophical dialogue of Socrates was presented under a truly dramatic form.

While philosophy was making such important progress, history rapidly approached perfection. In the period of 550–500 B.C. traditions were first committed to writing in prose, and Cadmus of Miletus (fl. 540), Acusilaus the Argive, Hecatæus of Miletus (fl. 500), Hellanicus of Mitylene, and Pherecydes of Scyros, are among the oldest historical writers (fl. 450). These are known as the logographers (*logographoi*), a name given to them by Thucydides. After them appeared Herodotus (born 484), the Homer of history. His example kindled Thucydides (born 471) to emulation, and his eight books of the history of the Peloponnesian war make him the first philosophical historian, and a model for all his successors. If his conciseness sometimes renders Thucydides obscure, in Xenophon (born about 444), on the contrary, there prevails the greatest perspicuity; and he became the model of quiet, unostentatious historical writing. These three historians are the most distinguished of this period, in which we must, moreover, mention Ctesias (fl. 400), Philistus (fl. 363), and Theopompus (fl. 340).

An entirely new species of poetry was created in this period. From the thanksgiving festivals, which the country people solemnized after the vintage, in honour of Dionysus (Bacchus), with wild songs and comic dances, arose, especially in Attica, the drama. By degrees variety and a degree of art were given to the songs of the village chorus, and by and by an intermediate speaker was introduced, who related popular fables, while the chorus varied the eternal praises of Bacchus by moral reflections, as the narration prompted. These games of the feast of the vintage were soon repeated on other days. Solon's contemporary, Thespis, who smeared his actors, like vintagers, with lees of wine, exhibited at the cross ways or in the villages, on movable stages, stories sometimes serious with solemn choruses, sometimes laughable with dances, in which satyrs and other ridiculous characters excited laughter. Their representations were called tragedies (*tragōdiai*), that is, songs of the goat (so called either because the exhibition of a tragedy was in the earliest times accompanied by the sacrifice of a goat, or because a goat was the prize, or because the actors were clad in goat-skins); comedies (*kōmōdiai*, meaning either village songs, from *kōmē*, a village, or songs of revelry, from *kōmos*, revelry), festive dances, and satirical actions (*drama satyricum*). These sports were finally exhibited, with much more splendour, on the stages of the towns, and acquired a more and more distinct character by their peculiar tone and morality. Instead of an intermediate speaker, who related his story extemporaneously, Æschylus (525–456) first substituted actors, who repeated their parts by rote; and he was thus the actual creator of the dramatic art, which was soon carried to perfection; tragedy by Æschylus, Sophocles (495–406), and Euripides (480–406); comedy by Cratinus (519–422), Eupolis (fl. 449), Crates, but especially by Aristophanes (about 444–380). Under the government of the thirty tyrants the freedom which comedy had possessed, of holding up living characters to ridicule, was restricted, and the middle comedy was thus gradually formed, in which the chorus was abolished, and, with delineations of general character, characteristic masks were also introduced. The mimes of Sophron of Syracuse (fl. 460–420), dramatic dialogues in rhythmical prose, formed a distinct species, in connection with which stands the Sicilian comedy of Epicharmus (about 540–450).

Eloquence, the necessary outcome of the democratic institutions of many of the Greek states, likewise flourished during this period, and was speedily elevated to the rank of a fine art. Antiphon (fl. 440), Lysias (458–378), Isocrates (436–338), Isæus (420–348), Demosthenes (about 385–322), Æschines (389–314), were renowned masters of this art. We still possess the admired master-pieces of several of these orators. How near rhetoric was then to triumphing over poetry is manifested in Euripides, and there is no question that it had a considerable influence on Plato and Thucydides. Mathematics was now cultivated, and geography served to illustrate history. Astronomy is indebted to the Ionic school, arithmetic to the Italic, and geometry to the Academic school for many discoveries. As mathematicians, Meton, Euctemon, Archytas of Tarentum, Eudoxus of Cnidus, were celebrated. Geography was, particularly, enriched by voyages of discovery, which were occasioned by commerce; and in this view Hanno's voyage to the western coast of Africa, the Periplus of Scylax (a description of the coasts of the Mediterranean), and the discoveries of Pytheas of Massilia in the north-west of Europe, deserve mention. The study of nature was likewise pursued by the philosophers; but the healing art, hitherto practised by the Asclepiadæ in the temples, constituted a distinct science, and Hippocrates (about 460–357) became the creator of scientific medicine.

The following period is usually called the *Alexandrine*, and might be characterized as the *systematizing* or *critical period*. Athens did not, indeed, cease to sustain its ancient reputation; but during the greater part of the period Alexandria was in

reality the leading Greek city. From this and other causes the spirit of Grecian literature necessarily took another turn. Greece was now under a foreign yoke; great creative geniuses no longer arose either in the home country or in the colonies; and the use of an immense library tended to make erudition triumph over the free action of mind, which, however, could not be immediately overborne. In philosophy, Plato's acute and learned disciple Aristotle (384–322) appeared as the founder of the Peripatetic school, which gained distinction by enlarging the territory of philosophy, and by its spirit of system. He separated logic and rhetoric, ethics and politics, physics and metaphysics, and applied philosophy to several branches of knowledge; thereby producing economics, pedagogics, and poetics. He invented the philosophical syllogism, and gave philosophy the form which it preserved for centuries. His disciple Theophrastus (died 287 B.C.) followed his steps in the investigation of philosophy and natural history. But the more dogmatic was the philosophy of Aristotle, the more caution was requisite to the philosophical inquirer, and the spirit of doubt was salutary. This was particularly exhibited in the system of scepticism which originated with Pyrrho of Elis (fl. 330). A similar spirit subsisted in the middle and new academics, of which Arcesilaus (fl. 241) and Carneades (fl. 155) were the founders. The Stoic school, founded by Zeno of Citium in Cyprus (342–270), and the Epicurean, of which Epicurus (fl. 299–279) was the founder, were chiefly remarkable for the effect that they had in the development of moral speculation in opposite directions, which gradually brought about a great difference in the practice of the adherents of the opposite schools. Mathematics and astronomy made great progress in the schools at Alexandria, Rhodes, and Pergamus. And to whom are the names of Euclid (fl. 323–283), Archimedes (287–212), Eratosthenes (276–196), and Hipparchus (160–145) unknown? The expeditions and achievements of Alexander furnished abundant matter to history; but, on the whole, it gained in extent, not in value, since a preference for the wonderful over the actual had now become prevalent. The more gratifying therefore is the appearance of Polybius of Megalopolis (204–122), who is to be regarded as the author of the true method of historical exposition, by which universal history acquired a philosophical spirit and a worthy object. Geography, which Eratosthenes made a science, and Hipparchus united more closely with mathematics, was enriched in various ways. To the knowledge of countries and nations much was added by the accounts of Nearchus, Agatharchides, and others. With respect to poetry many remarkable changes occurred. In Athens the middle comedy gave place, not without the intervention of political causes, to the new, which approaches to the modern 'comedy of manners'. (See DRAMA.) Among the many poets of this class Menander (342–291) and Philemon (fl. 330) were eminent. To this period also belong the celebrated idyllic poets Theocritus (fl. 270), and his contemporary Bion, as well as Moschus, who lived about twenty years later. The other kinds of poetry did not remain uncultivated; we may mention the learned poetry of Callimachus and of Lycophron, the epic of Apollonius Rhodius, the didactic of Aratus and Nicander; but all these labours, as well as the criticisms of poetry and the fine arts, point to Alexandria; and we shall therefore pass them over in this place. (See ALEXANDRIAN SCHOOL.) The Septuagint or Greek translation of the Old Testament was a work of scholars of the Alexandrian school. The period subsequent to B.C. 146 is known as the Graeco-Roman. Polybius may be placed here as well as the other historians, Diodorus Siculus and Dionysius of Halicarnassus; while in the Christian era we have Josephus, Arrian, Appian, Herodian; the biographies of Plutarch, Diogenes Laertius, and Philostratus; the geographies of Strabo and Pausanias; the astronomy and geography of Ptolemy; the informatory works of Athenæus, Ælian, and Stobæus; the medical works of Galen; the satirical works of Lucian; and the Greek romances best represented in Heliodorus, Achilles Tatius, and Chariton. (See also BYZANTINE LITERATURE.)

The following are among the best works on Greek literature:—K. O. Müller's Geschichte der griechischen Litteratur (4th edition, 1882–84); Bergk's Griechische Litteraturgeschichte (1892–94); Bernhardy's Grundriss der griecnischen Litteratur (new edition, 1892); Mure's Critical History of the Language and Literature of Ancient Greece (1854–60); Mahaffy's Classical Greek Literature (1890); Jevons' History of Greek Literature (1890); Croiset's Histoire de la Littérature grecque (1889–95); Susemihl's Geschichte der griechischen Litteratur in der Alexandrinerzeit (1891–92).

GREECE, MODERN (Greek, *Hellas*), a kingdom in the south-east of Europe, corresponding, since the incorporation of Thessaly, very nearly to ancient Greece, in the narrower sense; bounded on the north by Turkey, and on all other sides by the sea—the Ionian Sea on the west, the Mediterranean proper on the south, and the Ægean Sea on the east. The mainland forms two chief portions, united by the narrow Isthmus of Corinth; a northern, called Northern Greece or Livadia, and a southern peninsula, called the Peloponnesus or Morea. By far the largest island is Eubœa, only separated from the mainland of Livadia by the narrow channel of Euripo. The other islands form several groups:—the Northern Sporades on the north-east of Eubœa, including Skiatho, Skopelo, Kilidromia, Pelago, Peristeri or Sakarino, and Skyro; the western Sporades, chiefly in the Gulf of Egina, or between it and the Gulf of Nauplia, including Hydra, Spezzia, Poros, Egina, and Koluri or Salamis; the Cyclades; and the Ionian Islands. See GREECE (ANCIENT). The capital and largest town is Athens.

Physical Features.—See GREECE (ANCIENT).

Divisions.—Greece was politically divided into sixteen nomarchies till 1899, when a new division into twenty-six nomarchies was introduced. The following table gives the names and areas of the old nomarchies, and their population according to the last census:—

Nomarchies.		Area sq. miles.	Pop. 1896.
Northern Greece:—	Attica and Bœotia	2,472	313,069
	Phocis and Phthiotis	2,044	147,297
	Acarnania and Ætolia	3,013	170,565
Peloponnesus:—	Argolis and Corinth	1,442	157,578
	Achaia and Elis	1,901	236,251
	Arcadia	2,020	167,092
	Messenia	1,221	205,798
	Laconia	1,679	135,462
Islands:—	Eubœa and Sporades	2,216	115,515
	Cyclades	923	134,747
	Corfu	431	124,578
	Zante	277	45,032
	Cephalonia	302	88,363
Thessaly:—	Arta	395	89,144
	Trikkala	2,200	176,773
	Larissa	2,478	181,542
	Total	25,014	2,433,806

Climate.—The climate is generally mild, in the parts exposed to the sea equable and genial, but in the mountainous regions of the interior sometimes

very cold. None of the mountains attain the limit of perpetual snow; but several of them are so lofty as to retain a covering of it after the summer has far advanced. In general the first snow falls in October and the last in April. During the summer rain scarcely ever falls, and the channels of almost all the minor streams become dry. The air is then remarkably clear, and a month will sometimes pass away without a cloud being seen. A sudden change, however, takes place towards the end of harvest. Rain becomes frequent and copious; and the streams which had been dried up not only fill their channels, but frequently overflow them, and lay considerable tracts under water. In this way stagnant pools and marshes are occasionally formed, which give rise to intermittent fevers. Compare GREECE (ANCIENT)—Climate.

Vegetation, Agriculture, &c.—The cultivated land in Greece has recently been estimated at rather more than 3,500,000 acres, but of the land under cultivation about one-third is always fallow, according to the backward system of agriculture still pursued in Greece, where the plough commonly in use differs in no respect from that which Hesiod described 3000 years ago. Many ploughs of modern type are now being introduced, however, as well as other modern implements. The land is greatly subdivided, peasant proprietors being very numerous, and farming on a large scale is almost unknown. The improvement that has taken place of late years is nevertheless stated to be considerable. The produce of the arable land has greatly increased, and much additional land has been brought under cultivation. Thessaly is the richest portion of Greece agriculturally. The condition of the agricultural population is said to be very satisfactory. The principal cereal crops are wheat, barley, and maize, but the quantity raised is not sufficient, and much grain is imported. All the fruits of the latitude are grown—figs, almonds, oranges, citrons, melons, &c. —in abundance and of excellent quality, without receiving any great share of attention. The vine also grows vigorously, and considerable quantities of wine are made, some of the sorts being of high quality. But a much more important product of Greece, especially on the coasts of the Peloponnesus, and in the islands of Cephalonia, Zante, Ithaca, and Santa Maura, is the Corinthian grape or currant, the export of which has increased in value from £729,720 in 1866, to £1,511,670 in 1898. Another important object of cultivation is the olive, for which both the soil and the climate are alike favourable. The culture of the mulberry for the rearing of silk-worms is carried on to some extent. Some good tobacco is grown. The forests contain, among other trees, the oak (*Quercus Ægilops*) which yields the valonia of commerce. The live stock are neither numerous nor of good breeds. The raising of artificial grasses for their maintenance may be said to be unknown, and the scanty herbage which natural pasture affords must be of little avail. Asses and mules are more numerous than horses; cattle are comparatively few; and the chief animals from which dairy produce is obtained are the sheep and the goat. The quantity of wool produced is considerable, but most of it is of a coarse description.

Manufactures, Trade, Communications, &c.—The manufactures are limited, but with all other branches of industry in Greece are increasing, and are furthered by high duties on imported goods. The employment of the steam-engine in manufacturing industries dates from about 1868, and is yet only developed to a small extent. Piræus is the chief industrial centre, having spinning and weaving factories for cotton, silk, and wool, machine-shops, paper-works, dye-works, &c. Other centres are Syra, Corinth, Nauplia, Patras, Larissa. Still, cottons and other textiles form by far the most important part of the imports of manufactured goods. Leather manufactures form an important branch of industry. Marble has been worked from the most ancient period in the quarries of the island of Paros. In 1871 the working of the ancient argentiferous lead-mines of Laurion in Attica was resumed with good success; and quantities of manganese iron ore and zinc ore are also raised in this district. The most important branch of manufacturing industry is ship-building, which is carried on at various places. Much of the trade carried on is merely coasting, but the foreign trade also is of considerable extent. A large part of the foreign shipping of Greece is that which deals with the import of the manufactures of England, Germany, &c., into Greece, Turkey, and the Levant generally. In regard to this branch, the peculiar advantages which the Greeks possess in their knowledge of the languages, and acquaintance with the habits and wants, of the people of these countries, have been greatly in their favour. The chief ports of Greece are Piræus (the port of Athens), Syra, and Patras. The principal export is currants (very largely to Britain); but wine, olive-oil, dried figs, raisins, silver, lead, zinc ore, and manganese iron ore, tobacco, sponges, and other articles are also exported; the principal imports are cereals, coals, and cotton and woollen goods. The imports in 1891 were £5,560,052, the exports £4,299,588; in 1898, £6,083,400 and £3,577,530 respectively. The greatest hindrance to the development of Greece is the want of good roads, which are peculiarly necessary in so mountainous a country. Attention, however, has been directed to the supplying of this want, and there are now over 2000 miles of roads. Among other public works which have engaged the energies of the Greeks are the construction and restoration of harbours, the erection of lighthouses, the execution of drainage works, &c. In 1883 there were only 58 miles of railways open, but in 1898 591 miles were open, and 300 were under construction. A ship canal across the isthmus of Corinth was opened in 1893.

Weights, Measures, and Money.—The French metric system of weights and measures has been introduced into Greece by the government, but the people still adhere to the old system. In the latter the standard lineal measure was the *pikē*, equal to 27 inches; the standard square measure was the *stremma*, nearly equal to ¼ of an English acre; the standard weight was the *oke* = 2·8 lbs. avoirdupois: 44 okes were equal to 1 *cantar*, or about 124 lbs. avoirdupois. The weights and measures of the metric system are called royal, to distinguish them from the old weights and measures. In this system the French measures of length, millimètre, centimètre, décimètre, and mètre are called respectively *gramma, daktylos, palamē*, and *pēcheus* (cubit). The kilomètre is called a *stadion*, and the myriamètre *skoinis*. The new or royal measures of surface are the square pecheus = the square mètre, and the stremma = the are. The measures of capacity are the *kybos, mystron, kotylē, litra*, and *koilon*, respectively equal to the millilitre, centilitre, décilitre, litre, and hectolitre. The weights for gold, silver, and precious stones are the *kokkos, obolos*, and *drachmē*, respectively equal to the centigramme, décigramme, and gramme. The commercial unit of weight is the *mna* = 1500 drachmes = 1½ kilogramme. The *talanton* is equal to the quintal, and the *tonos* equal to the tonneau.

In 1875 Greece entered the monetary league of which the other members are France, Italy, Switzer-

land, and Belgium, and all the members of which have a monetary unit equal to the franc in value. The name of the Greek unit is the *drachme*, divided into 100 *lepta*, nominally equal to a franc; but varying considerably in value.

Government and People.—As first drawn up by the allied powers in 1830 the Greek monarchy was nearly absolute, but, in 1844, and again in 1864, important modifications were made. As settled by the present constitution the throne is hereditary according to the law of primogeniture in the family of King George. The king must be a member of the Greek Church. He attains his majority at the age of eighteen. The legislative authority is vested in a single chamber, called the Boulē, the members of which (proportioned in number to the amount of the population) are elected for four years by ballot by manhood suffrage. It meets every year on the 1st of November, unless called at an earlier date for special business. The executive power is exercised by the king through a responsible ministry. The Greek Church alone is established, but all other forms of religion enjoy toleration. The highest ecclesiastical authority, subject to the king, is vested in a permanent synod, which sits at Athens, and consists of five members appointed by the king from the highest dignitaries of the church. There is one metropolitan, who has his seat at Athens, twenty-one archbishops, and twenty-nine bishops, who are presented and ordained by the synod, and confirmed and invested by the king. Justice is administered, on the basis of the French civil code, by a supreme court (*Areios Pagos*), which has its seat at Athens; five higher courts, one at Athens, one at Nauplia, one at Patras, one at Larissa, and one at Corfu; and a number of courts of primary resort (*Protodokeia*), in the principal towns. The public revenue, derived chiefly from direct taxes, customs, stamps, excise, monopolies, the rent of national property, &c., was estimated for 1900 at £3,703,951, and the expenditure at £3,537,427. Greece has a very large public debt. In 1899 the amount of this debt was about £30,500,000. A considerable portion of the debt incurred in recent years has been in the way of raising loans for the making of railways. Of the foreign debt one loan is guaranteed by Great Britain, France, and Russia, which have latterly had to pay the dividends on it, and which are now accordingly heavy claimants on Greece. The payment of the interest on its public debt has long been with Greece a matter of difficulty. Every male Greek on attaining the age of twenty-one years is liable to military service, his term being two years with the colours, ten with the reserve, eight in the national guard, and ten in the national guard reserve. The army in 1900 numbered about 25,000 on a peace footing, expanding easily to 82,000 in time of war. The navy in 1900 consisted of 5 armour-clad ships, 51 torpedo-boats, besides several unprotected gunvessels and cruisers. The population contains a considerable intermixture of foreign stocks, among which the Albanese, or Arnauts, are the most numerous; but the great majority, though not without some taint in their blood, are of genuine Greek extraction, and, both in physical and mental features, bear a marked resemblance to their celebrated forefathers. It is true that the degrading bondage to which they were subjected for centuries has sunk them far below their natural level, and too often substituted sycophancy and low cunning for the intellectual superiority which, in earlier and better times, displayed itself in immortal productions of the chisel and the pen; but that the original elements of greatness still exist has been proved by the noble struggles which they have made for independence. The educational system of Greece, organized in 1834 by George Gennadius, one of the leaders of the war of independence, is very complete. There are three grades of schools, the demotic or primary national schools, the Hellenic or secondary grammar schools, and the gymnasia, in which, it is asserted, the range and the level of the teaching are much the same as in a German gymnasium or in the upper parts of our public schools. In all three grades of schools education is gratuitous, and in the primary schools it is compulsory on all children between five and twelve. There is a university at Athens, attended by nearly 3000 students, many of whom come from districts under the rule of the sultan. Thus far, however, education seems to be actually diffused among the people only to a limited extent, though the numbers that receive a university education are so great that many such young men find themselves without any proper sphere of employment, and are obliged to adopt the career of politician and place-hunter. Many of these are now, however, said to be finding better ways of turning their education to account through the rapid development of trade and industry. The national dress of the Greeks resembles the Albanian costume. In the men it consists of a tight jacket, generally scarlet, a white linen kilt in numerous folds, a bright-coloured sash round the waist, and embroidered gaiters; in the women it consists of a vest or jacket fitting close to the shape, and a skirt, on the head a kind of fez or skull-cap.

History.—From the year 1715 (see preceding article) till 1821 the Greeks were subject to the domination of the Turks. In 1770, and again in 1790, they made attempts at insurrection, which, however, were speedily frustrated. In the early years of the nineteenth century a secret society was formed for the purpose of effecting their liberation from the galling yoke, and in 1821 they found an opportunity of breaking out into another insurrection, which in the end proved successful. In that year Ali, the pasha of Janina, revolted against the Sultan Mahmoud II., and secured the aid of the Greeks by promising them their independence. The rising of the Greeks took place on the 6th of March, under Alexander Ypsilanti, and on the 1st of January, 1822, they published a declaration of independence. In the same year Ali was assassinated by the Turks, but the Greeks nevertheless continued the struggle that they had begun, and in which they were encouraged by the sympathy of nearly all the nations of Europe. Among the most distinguished of their leaders were Marcos Bozzaris, Capo d'Istria, Constantine Kanaris, Kolocotroni, Miaulis, Mavrocordato, Mavromichaelis, &c. In 1823 they were joined by Lord Byron, who, during the last year of his life, did all in his power to further their cause by his wealth, as well as by his active efforts on their behalf. Unfortunately he died in the April of the following year. In 1825, the Turks having called to their aid Mehemet-Ali, the pasha of Egypt, the latter sent his son, Ibrahim Pasha, whose talents secured them the success that they had hitherto been unable to attain. Tripolitza, the capital of the Morea, was taken, as was also Missolonghi, in spite of the valour of the Suliote mountaineers. It was about this time that the Greek patriots received the aid of the English admiral Lord Cochrane, who organized their fleet, and of the French colonel Fabvier, who instructed their army in the system of European tactics. In spite of this, however, the Turks continued to triumph everywhere, and resisted all the pressure that was put upon them by other European powers to make concessions. A treaty was then concluded at London (July 6, 1827) between Britain, France, and Russia, for the pacification of Greece, and when the mediation of these three powers was declined by the sul-

tan, their united fleets, under Admiral Codrington, attacked and annihilated the Turkish fleet off Navarino, Oct. 20, 1827. In the beginning of the following year (1828) Count Capo d'Istria became president of the state, and later on in the same year Ibrahim Pasha was forced to evacuate Greece. At last, on the 3d of February, 1830, a protocol of the allied powers declared the independence of Greece, which was recognized by the Porte on the 25th April of this year. The new member of the states of Europe received from the allies a monarchical form of government, and offered the crown to Leopold, prince of Saxe-Coburg, and when he refused it, to Otho, a young prince of Bavaria. The latter accepted the offer, and was proclaimed king of the Hellenes at Nauplia, on the 30th of August, 1832. The power of the king was at first almost absolute, and his arbitrary measures, and more especially the preponderance which he gave to Germans in the government, soon made him unpopular. At the same time the finances of the kingdom were in a very embarrassed condition, and a general uneasiness prevailed. In 1843 a rebellion took place, after which a constitution was drawn up. But Otho was after that no more popular than before, and after the outbreak of another rebellion in Feb. 1862, he saw himself compelled to abdicate the throne (Oct. 24). A provisional government was then set up at Athens, and the National Assembly, after declaring that the throne had been forfeited by Otho, offered it in succession to Prince Alfred of England and Prince William George of Denmark. The latter accepted it, and on March 30, 1863, was proclaimed as King George I. At the end of that year a constituent assembly was elected for the purpose of framing a new constitution, and the result of its labours was the constitution which is still in force. In 1864 an addition was made to the small kingdom by the annexation of the Ionian Islands, which had hitherto formed an independent republic under the protection of Britain. From the first Greece has been watching for an opportunity of extending its frontier northwards, so as to include the large Greek population in Thessaly and Epirus. In January, 1878, during the Russo-Turkish war, Greek troops were moved into Thessaly and Epirus to the assistance of their brethren who had risen there, but on the remonstrance of England these troops were withdrawn. The Treaty of Berlin made no definite provisions for any extension of the Greek territory, but in 1881 Turkey had to cede about 5000 square miles of Thessaly to Greece. After the union of Eastern Roumelia with Bulgaria, in 1885, war with Turkey was only prevented by the great powers. In 1896 an insurrection of the Christians in Crete led to the interference of Greece and to war with Turkey. The Turks speedily drove back the Greeks from the northern frontier and overran Thessaly; and Greece was enabled only through the efforts of the great powers to obtain reasonable terms of peace. The recent internal political history of Greece relates mainly to her financial obligations. After the expulsion of the Turkish troops from Crete in 1898 the Crown-prince George was appointed High Commissioner of the island.

Modern Greek Language and Literature.—The Greek language seems to have preserved its purity longer than any other known to us; but a deadly blow was inflicted when the Greeks were enslaved by the fall of Constantinople (A.D. 1453). All the cultivated classes, who still retained the pure Greek, the language of the Byzantine princes, either perished in the conflict or took to flight, or courted the favour of their rude conquerors, by adopting their dialect. In the lower classes only did the common Greek survive (the *koinē*, *dēmodēs*, *haplē*, *idiotikē dialektos*) the vulgar dialect of the polished classes, the traces of which occur, indeed, in earlier authors, but which first appears distinctly in the sixth century. This Greek *patois* departed still more from the purity of the written language—which took refuge at court, in the tribunals of justice, and the halls of instruction—when the Frank crusaders augmented it by their own peculiar expressions, and the barbarians in the neighbourhood engrafted theirs also upon it. This popular dialect first appears as a complete written language in the chronicles of Simon Sethos, in 1070–80. After the Ottomans had become masters of the country all the institutions which had contributed to preserve a better idiom perished at once. The people, left to themselves, oppressed by the most brutal despotism, would finally have abandoned their own dialect, which became constantly more corrupt, had not the Greeks possessed a sort of rallying-point in their church. But even here, owing chiefly to the ignorance and corruption prevailing among the clergy, little could be found to prevent the further debasement of this fine dialect, which continued till the middle of the eighteenth century. About this time many of the Greeks began to resort for instruction to the universities of the West, whence they returned to their native country to animate their fellow-countrymen with the desire of making nearer approaches to the more civilized nations of Europe, so as not to remain behind in the general progress. One consequence of this was that the Greeks began to pay more attention to their mother tongue, and this tendency was increased by intercourse with the more refined West, by means of more frequent visits from intelligent men of that quarter to the ruins of Grecian greatness. The Patriarch (Samuel Eugene Bulgaris Theotokos) of Corfu, and the unfortunate Rhigas, may be mentioned as eminent at this period.

At first a large part of the literature of awakened Greece consisted of translations from the French, but the country now furnishes original writers in every department of literature. Among the theological works of modern Greece perhaps the most remarkable is that On Truth, by Pharmakidis (1852), which is one of the most important works in the modern Greek language. The philosophical and mathematical sciences are all well represented. For these branches of knowledge much has been done by the University of Athens, many of the professors of which have published manuals (some of which have no inconsiderable scientific value) on the subjects on which they lecture. With the exception of poetry, history is perhaps the department which has attracted most writers in the modern Greek language. On this head the long and learned dissertations prefixed by Spiridion Zampelios to his Popular Songs of Greece (Corfu, 1852), and Studies on Constantinople (1858), affording valuable and interesting materials for the history of Greece in the Middle Ages, deserve to be particularly mentioned. In the department of philology and scholarship Coray has performed important services by collecting a large mass of materials for acquiring a more thorough knowledge both of ancient and modern Greek; and after him Doukas, Darbaris, Asopios, and Rhangabe, ought to be noticed for their editions of the ancient classics with commentaries in modern Greek. At the head of the orators of the time of the struggle for independence stands Trikoupis, some of whose speeches were collected and published in 1829, and a second and enlarged edition of them in 1860. In the department of poetry a distinction must be made between that of the people and that of the cultivated classes. The former is represented chiefly in the songs of the Klephts and other songs dating from the war of independence.

which are a faithful mirror of the public life at the time to which they belong. At this period the war-songs of Rhigas were caught up by the whole nation and sung with enthusiasm. At a later period the two Soutzos, Panagios and Alexander, Calvos, Solomos, and others, earned distinction in the same kind of poetry. The Soutzos were distinguished also as dramatists and novelists, and Alexander also as a satirist. Among the other leading dramatists are Rizos Neroulos and Zampelios. The most distinguished recent author, both a poet and a scholar, is A. R. Rangabé, while Demetrius Bikelas is the chief novelist.

Modern Greek, as spoken by the uneducated classes, is called Romaic, from the fact that it took on its special character at the time when the Greeks considered themselves as natives of the Roman Empire, and hence called themselves *Romaioi*, or Romans. The Greek of the educated classes, that used in the newspapers and other literature of the present day, is distinguished from it by a greater resemblance to the Greek of antiquity, which renders it easy for any one who has a satisfactory acquaintance with ancient Greek to read the literary Greek of the present day. The domain of the Romaic comprises not only the whole of the present Kingdom of Greece (including Thessaly), but also part of Roumelia, Albania, and Anatolia, the islands of Crete and Cyprus, as well as the islands of the Archipelago not belonging to Greece. The purest Romaic is spoken in the less frequented isles of the Archipelago, and in some of the mountainous districts of the interior. It is in these districts particularly that modes of expression are still found belonging to the most classical antiquity. At Megara the language is less corrupt than at Athens, where it is mixed with a considerable number of Italian words. In the northern provinces it is mixed chiefly with Albanian. Besides the foreign words which have been introduced into northern Greek, a pretty large number of words are found which have changed their original signification although they have retained their original form. Ancient words are most commonly found in significations the most remote from the original or derivative sense. The grammar has also undergone considerable modifications. For example, the numbers have been reduced to two by the suppression of the dual; and the cases to four, by the disappearance of the dative, the signification of which is now expressed by means of a preposition with the accusative. The first of the cardinal numerals is now used as an indefinite article. The degrees of comparison are sometimes expressed by the ancient inflexions, but at other times by the use of *pleon* (more). The past tenses of the verb are formed by the aid of the verb *echō* (I have), and the future tenses by the aid of *thelō* (I will). The infinitive mood, which has fallen out of use, has its place supplied by a periphrasis, in which the verb is put in the subjunctive. The middle voice has disappeared, and what remains of the old conjugation is of so little consequence that it may be regarded as an irregularity. The ancient orthography of the language is still preserved, but considerable changes appear to have taken place in the pronunciation. The vowels *η*, *ι*, and *υ*, and the dipthongs *ει*, *οι*, and *υι*, are all pronounced like *ea* in the English word *mean*. B is now pronounced as *v*, and the sound of *b* is expressed by *μπ*. Δ is pronounced like *th* in *thus*, and *θ* like *th* in *think*.

GREEK CHURCH. In the first ages of Christianity numerous churches were founded by the apostles and their successors in Greek-speaking countries; in Greece itself, in Syria, Egypt, Mesopotamia, Asia Minor, Thrace, and Macedonia. These were subsequently called Greek, in contradistinction to the churches in which the Latin tongue prevailed. The tendency to a separation between the Eastern and Western churches was early laid in the diversities of language, modes of thinking, and manners among the different nations comprised in them. The removal of the seat of empire by Constantine to Constantinople, and the subsequent separation of the Eastern and Western empires, afforded the opportunity for these diversities to manifest themselves, and added political causes to the grounds of separation. During the earliest period the chief seats of influence in the Eastern Church were Jerusalem, Antioch, and Alexandria. The claims of Jerusalem and Antioch are obvious to readers of New Testament history, while in early ecclesiastical history Alexandria is famed as the seat of that mystical philosophy by which the Oriental Church was distinguished. The removal of the seat of empire to Constantinople first gave the metropolitan or patriarch of that city a claim of superiority over these more ancient sees; but the Bishop of Rome, the ancient seat of empire, still claimed a priority, which seems to have been acknowledged to the extent at least of precedence, though probably not of actual authority. In the Council of Constantinople in 381 the Patriarch of Constantinople was recognized as second to the Bishop of Rome and as holding similar authority. The authority of the Bishop of Rome had already made itself felt in the East, particularly in regard to the celebrated controversy respecting the celebration of Easter (see EASTER), and this decision of the council may be considered as a movement in the direction of independence. This movement was confirmed by the Council of Chalcedon (451), which gave the Bishop of Constantinople the same honours and privileges as the Bishop of Rome. The transference of the seat of empire to Constantinople did not reconcile the bishops of Rome to the loss of their ecclesiastical power. The resignation of the growing power of the new metropolitan see was strenuously opposed by Leo the Great, whose legates presided at the Council of Chalcedon, and from this time he appointed a resident legate at Constantinople to maintain his authority by constant communication with the emperor. In the struggle for supremacy now openly carried on, the advantage for many reasons lay with Rome. It was the West and not the East that was destined to take the lead in civilization, and acquire the ascendency in political power Even the circumstance which seemed to give a temporary advantage to the patriarch, the presence of the emperor, was owing to this tendency of events in favour of the pope. The former was restrained by the civil power; the latter was free to extend his own authority in a secular as well as in an ecclesiastical direction. The skill with which the Roman pontiffs availed themselves of this independence to establish their appellate jurisdiction, and their success in doing so even where their claims might seem most extravagant and unfounded, are well described in the seventh chapter of Hallam's Middle Ages. This policy was often exercised with success upon the Eastern emperors, who were thus induced to unite with the Bishop of Rome against their own metropolitans. The advantages acquired by the patriarchs in the struggle were thus liable to be suddenly overthrown by the turning against them of the very power on which they leaned. Thus in 588 the patriarch adopted the title of Universal Bishop, and in 607 this title was conferred by the Emperor Phocas on Pope Boniface III. The popes, however, did not always use their power skilfully. Excommunications were fulminated with too great freedom, and were the final cause of the severance of the two communions. Acacius, patriarch of Constantinople,

was excommunicated by Felix II. for having procured from the Emperor Zeno in 482 the edict Henoticon, or concordat between the churches of Constantinople and Alexandria. Photius was repeatedly deposed, and finally deprived of his see. This patriarch, one of the ablest and most strenuous upholders of the dignity of the see, was appointed by a court intrigue in 857. Previously a layman, he was advanced through all the grades of ecclesiastical authority to the patriarchate in six days. In his long struggle with the popes, in which he returned excommunication for excommunication, he was alternately supported and abandoned by the emperors. The missionaries of the Eastern Church were at this time more active than those of the Western. Christianity was rapidly extended by them among the Slavonic nations. The Bulgarians and the Russians were Christianized about the time of Photius. The popes, with their usual art, endeavoured to withdraw the former from their allegiance to the patriarchs, and to bring them under their own. This was one of the grounds of dispute with Photius. The difference between the two churches in doctrine and observances, particularly the question about the procession of the Holy Spirit, also now as at all times figured largely in the controversy. Photius died in a convent, after being three times driven from his see, about 891.

Michael Cerularius added to the charges of Photius against the Latins an accusation of heresy on account of their use of unleavened bread at the communion, and of the blood of animals that had died by strangulation, as well as on account of the immorality of the Latin clergy in general; but the real ground of controversy was the attempt of Pope Leo IX. to extend his authority over the patriarchs of Antioch and Alexandria. With singular audacity the legates of this pope excommunicated the patriarch in the church of St. Sophia, on the 16th of June, 1054. The excommunication was made reciprocal, and the breach between the two communions became complete. From this time pride, obstinacy, and selfishness frustrated all the attempts which were made to reunite the severed churches, partly by the popes, in order to annex the East to their see, partly by the Greek emperors (equally oppressed by the crusaders and Mohammedans), in order to secure the assistance of the princes of the West. The conquest of Constantinople by the French crusaders and the Venetians, A.D. 1204, and the cruel oppressions which the Greeks had to endure from the Latins and the Papal legates, only increased their exasperation; and although the Greek emperor Michael VIII. (Palæologus, who had reconquered Constantinople in 1261) consented to recognize the supremacy of the pope, and by his envoys and some of the clergy who were devoted to him, abjured the points of separation at the assembly of Lyons, A.D. 1274; and though a joint synod was held at Constantinople in 1277, for the purpose of strengthening the union with the Latin Church, the mass of the Greek Church was nevertheless opposed to this step, and Pope Martin IV., having excommunicated the Emperor Michael in 1281 from political motives, the councils held at Constantinople in 1283 and 1285 by the Greek bishop, restored their old doctrines and the separation from the Latins. The last attempt was made by the Greek Emperor John VII. (Palæologus, who was very hard pressed by the Turks), together with the patriarch Joseph, in the councils held, first at Ferrara, in 1438, and the next year at Florence, Pope Eugene IV. presiding; but the union concluded there had the appearance of a submission of the Greeks to the Roman see, and was altogether rejected by the Greek clergy and nation, so that, in fact, the schism of the two churches continued. The efforts of the Greek emperors on this point, who had always had most interest in these attempts at union, ceased with the overthrow of their empire and the conquest of Constantinople by the Turks, A.D. 1453; and the exertions of the Roman Catholics to subject the Greek Church effected nothing but the acknowledgment of the supremacy of the pope by some congregations in Italy (whither many Greeks had fled before the Turks), in Hungary, Galicia, Poland, and Lithuania, which congregations are now known under the name of *United Greeks*. In the seventh century the territory of the Greek Church embraced, besides East Illyria, Greece Proper, with the Morea and the Archipelago, Asia Minor, Syria, with Palestine, Arabia, Egypt, and numerous congregations in Mesopotamia and Persia; but the conquests of Mohammed and his successors have deprived it, since 630, of almost all its provinces in Asia and Africa; and even in Europe the number of its adherents was considerably diminished by the Turks in the fifteenth century. On the other hand, it was increased by the accession of several Slavonian nations, and especially of the Russians, who were compelled by the great prince Vladimir, in the year 988, to adopt the creed of the Greek Christians. To this nation the Greek Church is indebted for the symbolical book, which, with the canons of the first and second Nicene, of the first, second, and third Constantinopolitan, of the Ephesian and Chalcedonian general councils, and of the Trullan Council, held at Constantinople in 692, is the sole authority of the Greek Christians in doctrinal matters. After the learned Cyrillus Lascaris, patriarch of Constantinople, had atoned, with his life, for the approach to Protestantism perceptible in his creed, A.D. 1629, an exposition of the doctrine of the Russians was drawn up in the Greek language, by Pet. Mogislaus, bishop of Kiev, in 1642, under the title of the Orthodox Confession of the Catholic and Apostolic Church of Christ, signed and ratified, 1643, by all the patriarchs of the Greek Church, to whom had been added, in 1589, the fifth patriarch of Moscow. It was printed in Holland, in Greek and Latin, 1662, with a preface by the patriarch Nectarius of Jerusalem. In 1696 it was published by the last Russian patriarch Adrianus of Moscow; and in 1722, at the command of Peter the Great, by the holy synod; it having been previously declared to be in all cases valid, as the ritual of the Greek Church, by a council at Jerusalem, in 1672, and by the ecclesiastical rule of Peter the Great, drawn up in 1721, by Theophanes Procowicz.

The doctrines of the Greek Church have, since the Reformation, been a fruitful source of controversy between Catholic and Protestant writers. Each of the parties, while rejecting the authority of that church for themselves, being willing to adduce it when practicable against their opponents. The controversy, although entirely one of fact, has been conducted with the proverbial bitterness of theological controversies, accusations of fraud and falsehood being freely exchanged.

Like the R. Catholic, this church recognizes two sources of doctrine, the Bible and tradition, under which last it comprehends not only those doctrines which were orally delivered by the apostles, but also those which have been approved of by the fathers of the Greek Church, especially John of Damascus, as well as by the seven above-named general councils. The other councils, whose authority is valid in the Roman Catholic Church, this church does not recognize; nor does it allow the patriarchs or synods to introduce new doctrines. It treats its tenets as so entirely obligatory and necessary that they cannot be denied without the loss of salvation. It is the

only church which holds that the Holy Ghost proceeds from the Father only; thus differing from the Roman Catholic and Protestant Churches, which agree in holding that the Holy Ghost proceeds from the Father and the Son. Like the Roman Church, it has seven sacraments—baptism; chrism; the eucharist, preceded by confession; penance; ordination; marriage; and supreme unction. But it is peculiar—1, in holding that full purification from original sin in baptism requires an immersion three times of the whole body in water, whether infants or adults are to be baptized, and in joining chrism (confirmation) with it as the completion of baptism; 2, in adopting, as to the eucharist, the doctrine of transubstantiation, but not the adoration of the host; and in ordering the bread to be leavened, the wine to be mixed with water, and both elements to be distributed to every one, even to children, before they have a true idea of what sin is, the communicant receiving the bread broken in a spoon filled with the consecrated wine; 3, all the ordinary clergy are required to marry (a virgin, but not a widow), but they are not allowed to marry a second time; and therefore the widowed clergy are not permitted to retain their livings, but go into a cloister, where they are called *hieromonachi*. Celibacy is enjoined upon bishops and monks; and from the maxim that marriage is not suitable for the higher clergy in general, and second marriage at least is improper for the lower, there is no departure. The Greek Church does not regard the marriage of the laity as indissoluble, and frequently grants divorces for adultery, but it is as strict as the Roman Church with respect to the forbidden degrees of relationship, especially of the ecclesiastical relationship of god-parents; nor does it allow the laity a fourth marriage. It differs from the Roman Church in anointing with the holy oil, not only the dying but the sick, for the restoration of their health, the forgiveness of their sins, and the sanctification of their souls. It rejects the doctrine of purgatory (in the ordinary sense at least), works of supererogation, indulgences, and dispensations, but admits prayers for the dead, whose condition appears to be considered undetermined until the final judgment. A good deal of latitude of opinion prevails on this subject. Absolution is given in the form of a prayer; not 'I absolve thee', but 'May the Lord absolve thee'. It recognizes neither the pope nor anyone else as the visible vicar of Christ on earth, but the spiritual authority claimed for the patriarch of Constantinople is little if at all inferior to that of the pope. It moreover allows no carved, sculptured, or molten image of holy persons or subjects (crucifixes included); but the representations of Christ, of the virgin Mary, and the saints, which are objects of religious veneration (carried indeed to an extreme degree) in churches and private houses, must be merely painted, and at most inlaid with precious stones. In the invocation of the saints, and especially of the Virgin, the Greeks are as zealous as the Roman Catholics. They also hold relics, graves, and crosses sacred; and crossing in the name of Jesus they consider as having a wonderful and blessed influence. Among the means of penance, fasts are particularly numerous with them, at which it is not lawful to eat anything but fruits, vegetables, bread, and fish. They fast on Wednesday and Friday of every week, and besides observe four great annual fasts, namely, forty days before Easter; from Whitsuntide to the days of St. Peter and Paul; the fast of the virgin Mary, from the 1st to the 15th of August; and the apostle Philip's fast, from the 15th to the 26th of November; besides the day of the beheading of John the Baptist, and of the elevation of the cross.

The services of the Greek Church consist almost entirely in outward forms. Preaching and catechising constitute the least part of it; and in the seventeenth century preaching was forbidden in Russia, under the czar Alexis, in order to prevent the diffusion of new doctrines. Each congregation has its choir of singers, who sing psalms and hymns. The congregations themselves do not sing from books, and instrumental music is excluded altogether from the Greek worship. Besides the mass, which is regarded as the chief thing, the liturgy consists of passages of Scripture, prayers, and legends of the saints, and in the recitation of the creed, or of sentences which the officiating priest begins, and the people in a body continue and finish. The convents conform, for the most part, to the strict rule of St. Basil. The Greek abbot is termed *higumenos*, the abbess *higumene*. The abbot of a Greek convent which has several others under its inspection is termed *archimandrite*, and has a rank next below that of bishop. The lower clergy in the Greek Church consist of readers, singers, deacons, &c., and of priests, such as the popes and protopopes or archpriests, who are the first clergy in the cathedrals and metropolitan churches. The members of the lower clergy can rise no higher than protopopes, for the bishops are chosen from among the monks, and from the bishops, archbishops, metropolitans, and patriarchs. In the Russian empire there are over sixty dioceses. The emperor is the head of the church, and has the appointment of persons to all ecclesiastical dignities, but does not claim to decide theological or dogmatic questions. There are three metropolitans and seventeen archbishops. The patriarchal dignity of Moscow was abolished by Peter the Great in 1702, and in 1721 the whole church government of his empire was intrusted to a college of bishops and secular clergy, called the *holy synod*, first at Moscow, now at St. Petersburg. The Greek Church, under the Turkish dominion, remained, as far as was possible under such circumstances, faithful to the original constitution. The patriarchate was tolerated by the Turks, who left the Christians the exercise of their religion, but the liberty to appoint a new patriarch had to be purchased from the government, which opened the way to abuses. Whenever a faction was discontented with their patriarch they could for a bribe secure his dismissal and the appointment of another. The dignities of Patriarch of Alexandria, Antioch, and Jerusalem still subsist. The Patriarch of Constantinople still possesses, nominally at least, the ancient authority of his see; takes the lead as œcumenical patriarch in the holy synod at Constantinople, composed of the four patriarchs, a number of metropolitans and bishops, and twelve principal secular Greeks; exercises the highest ecclesiastical jurisdiction over the Greeks in the whole Turkish Empire, and is recognized as head of the Greek Church even outside the Turkish dominions. The church in the kingdom of Greece, however, has an independent position, as also in Roumania and Bulgaria. The other three patriarchs exercise a very limited jurisdiction, and live for the most part on the aid afforded them by the Patriarch of Constantinople. The Patriarch of Alexandria presides only over a few churches; the adherents of the patriarchate of Antioch are also by no means numerous; while the Patriarch of Jerusalem resides chiefly at Constantinople, and exercises an authority over the holy places held by the Greek monks in Palestine. The question of these holy places constituted ostensibly the original cause of embroilment between Russia and Turkey which terminated in the Crimean war,

the Emperor of Russia claiming the right of interfering on behalf of the Greek Church as its protector. Since the termination of the war the adherents of the Greek Church in Turkey have been freed from numerous invidious restrictions, civil and religious, to which they were formerly subjected.

For a long time the attachment of this church to old institutions has stood in the way of all attempts at improvement. Such attempts have given rise to a number of sects, which have at times suffered severe persecution. As early as the fourteenth century the party of the Strigolnicians seceded from hatred of the clergy, but as they had no other peculiarity, soon perished. The same was done with more success by the Roskolnicians (that is, the apostates) about 1666. (See ROSKOLNICIANS.) This sect, which by degrees was divided into twenty different parties, by no means forms a regular ecclesiastical society, with symbols and usages of its own, but consists of single congregations, independent of each other, which are distinguished from the Greek Church by preserving unaltered the ancient Slavonian liturgy, &c.; have a consecrated clergy; and having retired from early persecution have become numerous in the eastern provinces of the Russian Empire. The different parties conform more or less to the peculiarities attributed to the Roskolnicians in general, such as declaring the use of tobacco and of strong drink sinful, fasting yet more strictly than the orthodox church, refusing to take oaths; and are, from a fanatical spirit similar to that of the former Anabaptists, inclined to rebellion against their rulers. Pugatschef, himself a Roskolnician, found most of his adherents among them in his rebellion. At present they have relaxed much of their strictness on these points, as well as their fantastic notions with respect to marriage, dress, the priesthood, and martyrdom, and seem to be gradually merging among the orthodox. The Philippones (which see) were exiled Roskolnicians, who settled in Lithuania and East Prussia, under Philip Pustoswiæt. Farther removed from the belief of the Greek Church are the Duchoborzy, a sect settled on the steppes beyond the Don, who reject the doctrine of the Trinity, and receive the Gospels only, have no churches nor priests, and regard oaths and warfare as unlawful. Antitrinitarians, of a similar kind, are the *Russian Jews*, as they are called, in the governments of Archangel and Ekaterinoslav, who worship neither Christ nor the saints, reject baptism, and have no priests nor churches. Respecting the ancient schismatical and heretical religious parties in Asia and Africa that have proceeded from the Greek Church see COPTS, ABYSSINIA, JACOBITES, NESTORIANS, MARONITES, ARMENIANS.

GREEK FIRE was invented in the seventh century. When the Arabs besieged Constantinople in 668, the Greek architect Callinicus of Heliopolis deserted from the caliph to the Greeks, and took with him a composition, which, by its wonderful effects, struck terror into the enemy, and forced them to take to flight. Sometimes it was wrapped in flax attached to arrows and javelins, and so thrown into the fortifications and other buildings of the enemy, to set them on fire. At other times it was used in throwing stone balls from iron or metallic tubes against the enemy. Judging from its effects, it has been said that neither naphtha, sulphur, nor rosin was a principal ingredient; but saltpetre probably was. It does not appear that it burned *under* water, but merely that it burned *upon* it. Cardan invented a species of fire of this description. A dissertation on the Greek fire, containing a receipt for its composition, was discovered in a Latin MS. at Munich, belonging to the thirteenth century. A similar MS. was discovered in the imperial library at Paris, and the parts relating to the Greek fire have been published. For an account of this, see MARCUS GRAECUS.

GREENBACKS, the popular name given to the paper currency first issued by the United States government during the civil war from 1861 to 1865.

GREEN CLOTH, in England, a court of justice, held in the counting-house of the royal household, composed of the lord-steward and officers under him, who sat daily. To this court was committed the charge and oversight of the sovereign's household in matters of justice and government, with a power to correct all offenders, and to maintain the peace of the verge, or jurisdiction of the court royal, which is every way about 200 yards from the last gate of the palace where majesty resides. The jurisdiction of this court has now wholly fallen into desuetude.

GREENE, NATHANAEL, a general of the American revolutionary army, was born at Warwick, Rhode Island, 27th July (O.S.), 1742. His father, a leading preacher among the Quakers, had an anchor-forge and a grist-mill at Warwick. He was trained to work in the mill and forge, and to attend to his father's farm. From casual intercourse with a student of Rhode Island College he was inspired with a desire for knowledge, which he pursued in spite of obstacles, and acquired by his own exertions an acquaintance with English and ancient history, geometry, law, moral and political science. Having taken charge of a new forge which his father had added to his stock at Coventry, he was in 1770 elected to represent that place in the general assembly of Rhode Island, and from this time he took an active part in public affairs. He established a public school in Coventry, and was one of the first to engage in military exercises as a preparation for resisting the encroachments of the mother country. For this violation of the principles of the Quakers he was openly excommunicated. In 1774 he joined the Kentish Guards, in which he had failed to obtain a commission, as a private. In May, 1775, he was appointed by the general assembly brigadier-general and commander of the Rhode Island contingent in the army before Boston. He gained at once the confidence of Washington. After the evacuation of Boston he was intrusted with the defence of Long Island, but was taken ill and had to devolve his command to General Sullivan, before the attack and capture of the island by General Howe on 27th August, 1776. In September he was made major-general, and appointed to the command in New Jersey. At Trenton (26th December, 1776) and Princeton (2d January, 1777) he led a division of Washington's army. At Brandywine, Germantown, Monmouth Court-house, Tiverton Heights, and Springfield he also held important commands, and repeatedly distinguished himself. From March till August, 1778, he occupied the position of quarter-master-general. In September, 1780, he presided at the trial of Major André. In October he was appointed to the command of the southern army, and in a series of chequered but successful operations he succeeded, after repeated defeats, in wresting Georgia and the Carolinas from the British. He died 19th June, 1786.

GREENE, ROBERT, a British dramatist, was born in Norwich about 1560. He studied at St. John's College and Clare Hall, Cambridge, and afterwards at Oxford, and took his degree of B.A. in 1578, after which he travelled on the Continent. He graduated M.A. in 1583. Little else is known about him except from his own writings, in which it is difficult to separate fact from fiction. He died on Sept. 3, 1592. It is certain he lived a wild and profligate life, and he appears to have died in poverty.

He was one of the first who endeavoured to support themselves by their writings. His works consist of plays, poems, tales, and tracts. They are numerous, but are not held in much estimation by modern critics. A Groat's Worth of Wit Bought with a Million of Repentance, licensed in 1592, after his death, is remarkable for an allusion to Shakspere as a dramatist. He is there termed by Greene, who is supposed to be addressing some of his brother dramatists, 'an upstart crow, beautified with our feathers'. One of Greene's plays, Friar Bacon and Friar Bungay, is contained in Coleridge's edition of Dodsley's Collection of Old Plays. Of his dramatic works may be mentioned, as a specimen, the History of Orlando Furioso, and a Looking-glass for London and England; of the non-dramatic, The History of Dorastus and Fawnia, Farewell to Folly, The Repentance of Robert Greene, and Thieves Falling Out. In 1831 Dyce published an edition of his plays and poems in two volumes; and in 1881–86 Dr. Grosart edited his complete works in fifteen volumes. He also published in 1894 a selection from his works under the title Green Pastures.

GREEN EARTH, an opaque, dull, olive-green, soft, earthy mass, is generally met with in cavities in amygdaloidal rocks. It is found in various parts of the British Islands, especially in the traps, and it is generally regarded as a decomposition product of augite. It consists of silicate of iron and aluminium, with potassium and sodium and water. A sort of green earth, known as *mountain green*, is used by painters in water-colours.

GREENFINCH, or GREEN LINNET (*Ligurinus chloris*), a bird of the finch family (Fringillidæ), one of the most common of British birds. It frequents hedges, gardens, shrubberies, and small plantations, and feeds on grain, seeds, or insects. Its song is not melodious, and it is not much thought of as a cage bird, though it easily becomes tame and quite familiar. It breeds from about the end of April on to June, and builds its nest in hedges, bushes, and low trees. The nest is mainly composed of green moss and coarse fibrous roots, and is lined with finer roots, horse-hair, and feathers. The eggs are four to six in number, bluish-white, spotted at the larger end with purplish-gray and dark-brown. The general colour of the male on the upper parts is olive-green; the primaries grayish-black, with bright yellow edges for two-thirds of their length; under parts yellow. The female is of a brownish colour. The male, which is a little larger than the female, is about 6 inches in length.

GREEN GAGE, a variety of the plum, the *reine claude* of the French, introduced into England by a person named Gage. It is large, of a green or slightly yellowish colour, and has a juicy, greenish pulp of an exquisite flavour. Several varieties are distinguished.

GREENHEART TREE (*Nectandra Rodiœi*), a tree of the natural order Lauraceæ, a native of Guiana, called also the *bebeery*. The wood of this tree, which is hard and durable, and takes a fine polish, is imported largely from Demerara, and used in ship-building. The bark contains the alkaloid *bebeerine* or *bibirine*, which is used in medicine in the form of a sulphate. It is a powerful tonic. Other species of the genus are valuable.

GREENHOUSE, a building constructed chiefly of glass for the preservation of plants which are too delicate to be exposed at all seasons to the open air. A greenhouse is now usually distinguished from a hothouse by not requiring artificial heat during summer, and from a conservatory in having the plants in pots and not in the ground. Formerly greenhouses were built with glass in front, the roof, back, and ends being dark. The growth of plants in such houses was one-sided. The importance of light to vegetation is now better appreciated, and greenhouses are made of a much lighter construction, and glass freely used in all parts of them. The lean-to form, in which advantage is taken of a house or garden wall as a support, is yet frequently used; but the span or arched-roofed structures, with glass on all sides, admit of a more symmetrical growth of plants. The form of greenhouses differs according to architectural taste and surrounding circumstances. The materials used are chiefly glass, wood, and iron. See CONSERVATORY.

GREENLAND (Danish and German, *Grönland*), an extensive island belonging to Denmark, situated on the north-east of the continent of North America. From the inaccessible nature of much of its coast, a part of its northern and eastern outline is as yet but little known, or entirely unknown. The most northerly point of the country as yet seen is Cape Washington, whose latitude is about 83° 38′ N. Its west coast, which has been most accurately examined, is washed by Davis Straits, Baffin Bay, and Smith Sound, and stretches north from Cape Farewell, in latitude 59° 48′. Its eastern shore, commencing at the came cape, is washed by the North Atlantic and Arctic Oceans, but it is only the southern part of this coast that can be considered as explored. The part north of Cape Bismarck, extending past Independence Bay to Cape Washington, is still wholly unexplored. The Danish colony extends north, on the western coast, to Tasiusak, in 73° 22′ north latitude. Here the sun remains below the horizon for some weeks in winter, though the long darkness is much reduced by bright moonshine, the stars, and the northern lights. In summer, on the other hand, the light of the sun is continued, without intermission, for a similar period. Farther south, where the sun regularly rises and sets throughout the year, a short but warm summer, during which snow does not melt even in the valleys before July, is followed by a long and dreary winter, the cold of which, though very great, particularly in February and March, is greatly modified on the coast by the sea, and therefore not so extreme as the latitude might seem to indicate. The interior is lofty, and has the appearance of one vast glacier, with occasional spots of a dark or grayish hue, on which, from their smoothness and steepness, snow and ice have not been able to accumulate, and some heaths and mosses succeed in maintaining an existence. The whole of this interior is uninhabitable, and all the villages, whether of natives or Europeans, are confined to the coasts, which are generally rocky and precipitous, but occasionally flattened down and open into low valleys. They are lined with numerous islands, and deeply penetrated by fiords. Vegetation is almost confined to the low shores and valleys, where grassy meadows sometimes occur with stunted shrubs and trees. In the most sheltered spots the birch and alder gain a height of about 6 feet, and a stem from 3 to 4 inches in thickness. The attempts to raise oats and barley have failed, but potatoes have been grown towards the southern extremity. Turnips attain the size of a pigeon's egg, and cabbages grow very small. The radish is the only vegetable which seems not to be checked in its growth. The inhabitants of the Danish colony number about 10,500, and are nearly all Esquimaux. (See ESQUIMAUX.) The hardships endured by the missionaries who undertook their conversion, and the success which suddenly crowned their labours after they had almost resolved to abandon them in despair, form one of the most interesting chapters in the history of missionary enterprise. For

administrative purposes Greenland, or rather its coast, is divided into the two inspectorates of North Greenland and South Greenland, the former subdivided into seven, the latter into six colonies or districts. Godhavn (pop. 250), on the island of Disco; and Godhaab (pop. 740), where Hans Egede, the Norwegian clergyman, established the first European colony, being the residences of the north and south inspectors, may be regarded as the capitals; but the best inhabited district is that of Julianshaab, in South Greenland: its pop. is 2200.

Like the north-east of N. America generally, Greenland is colder than the corresponding latitudes on the east side of the Atlantic. In latitude 60° the temperature is said to be lower than at 72° in Lapland. The temperature observed by Dr. Kane, from 1853 to 1855, on the north-west coast, lat. 78° 37′ N.; lon. 70° 40′ W., included a maximum of 53° 9′, and degrees of temperature as low as —68° and —69°. In June and July the sun, which is constantly above the horizon, causes the ice on the coasts to be broken up and float towards the south. It also opens a few small lakes, into which the streams from the melting snow and ice of the interior flow. These desolate regions have, however, a vegetation peculiar to themselves. Cryptogams and flowerless plants are numerous, and there are numerous species of flowering plants; but the growth of these, like that of the shrubs, is stunted when compared with more favoured climes. The sea abounds with cetaceous animals (see WHALE). The Esquimaux dog, the reindeer, the polar bear, and the arctic fox are among the land animals, the walrus and the seal among the amphibia, and seafowl, are very numerous in summer.

Greenland was discovered by an Icelander named Gunnbjörn, about 876 or 877. It was colonized from Iceland about the end of the tenth century, and other Scandinavians subsequently followed. About the year 1000 there were already 190 settlements and several monasteries, and Gardar, in the neighbourhood of the modern Frederikshaab, afterwards became the seat of a bishop. Greenland was politically united with Norway in 1264. About the middle of the fourteenth century there were in the western colony (West Bygd) four churches and 110 farms; in the eastern colony (East Bygd), two towns, one cathedral, eleven other churches, and 190 farms. The flourishing state of these settlements, however, lasted only till about this period, after which they gradually vanish from history. The last mention of them is made in a document drawn up by the last bishop in 1408. The causes of this decline are to be looked for in the effects of commercial monopolies, the attacks of the Esquimaux, and the ravages of a hostile fleet—of what country is not known—and not in a sudden change of climate. The remains of the colony may still have been in existence in the fifteenth century; but amid the storms of the Reformation and the change of dynasty, Greenland was forgotten in the mother country. The expeditions sent by Denmark in 1585, 1606, 1636, 1654, and 1670 for the purpose of finding the colony were unsuccessful. Relics of the former colonists have been found in the shape of tombstones with Runic inscriptions and inscriptions in the Icelandic character of the twelfth century, coffins with skeletons, the ruins of a church, &c. It has been proved in modern times that both the East and the West Bygd were on the west coast of Greenland, and nothing is known of any settlements on the east coast. In the reign of Queen Elizabeth Frobisher and Davis again discovered the coast of Greenland. From that time nothing was done to explore this country until the Danish government, in 1721, assisted a clergyman, Hans Egede (see EGEDE—HANS), with two ships, to effect a landing in 64° 5′, and establish a European settlement, Good Hope (*Godhaab*), on the river Baal. In 1733 the Moravian Brethren were induced by Count Zinzendorf to attempt the establishment of settlements and missions on these inhospitable shores. Whale-fisheries were established on the coast by the English and Dutch about 1590. In 1693 the Greenland Company was incorporated. Its privileges were extended to all whale-fishers by act 1 Anne, cap. xvi. in 1714. The interior of the country was first crossed from east to west by Dr. Nansen in 1888.

GREEN MOUNTAINS, so called from the forests of green trees with which they are covered, a mountain range United States, commencing near Newhaven, Connecticut, and extending north through Massachusetts and Vermont, between Lake Champlain and the Connecticut River. The highest summits are Mansfield Mountain and Camel's Rump, both in Vermont, respectively 4279 and 4188 feet high.

GREENOCK, a parliamentary burgh and seaport town of Scotland, county of Renfrew, on the southern shore of the estuary of the Clyde, which is here between 3 and 4 miles wide, about 20 miles west by north of Glasgow. It stands partly on a narrow level tract of land stretching along the margin of the sea; and partly on some fine commanding heights, which rise behind, and to the south and west of the lower parts of the town. The view from these eminences is singularly beautiful, comprising the extensive bay in front, with the shores and hills of Argyle and Dumbarton shires in the distance; while the neat and tasteful villas with which they are crowded impart to them a very pleasing and picturesque appearance when viewed from the sea. A number of elegant residences also line the shore to the west. The lower and older parts of the town are mean and crowded, but a town improvement scheme has effected great changes for the better. In the modern portions the streets are spacious, airy, and clean. The principal public buildings, exclusive of the churches—some of which are handsome structures—are the municipal buildings (cost £100,000), a renaissance structure, with a tower 245 feet high; the custom-house, a Grecian edifice, with a fine portico; the Watt Institution, in the Elizabethan style, containing the public library, the entrance adorned by a marble statue of Watt by Chantrey; the Watt Museum and Lecture Hall adjoining this building; the sheriff-court buildings, post-office, exchange, banking offices, Princes Pier railway-station, &c. The schools comprise the Greenock Academy, Highlanders' Academy, technical education schools, and a number of others all under the burgh school-board. The principal charitable institutions are the Greenock Hospital and Infirmary, the Greenock Eye Infirmary, and the Mariners' Asylum, an elegant Elizabethan building, endowed by the trustees of the late Sir Gabriel Wood, for masters, mates, and seamen belonging to the counties bordering the Clyde; there are several others of less prominence. The literary, scientific, and other institutions comprise the public library, a mechanics' institute with library, a philosophical society, a school of art, a school of navigation and civil engineering, a reading-room, a chamber of commerce, &c. South-west of the town, overlooking the Clyde, is a beautiful well-laid-out cemetery. There are several parks devoted to the recreation of the public, and the esplanade, 100 feet wide and 6200 feet long, constructed along the margin of the river at the west end, forms a fine promenade. An abundant supply of water is obtained from the Gryfe and Loch Thom. The manufactures of Greenock include numerous sugar-refineries, some of them on

a large scale; ship-building yards; iron-foundries and machine establishments for the construction of land and marine engines, locomotives, boilers, &c.; chain and anchor works; aluminium works; brass-foundries; felt manufactories; fire-clay works; worsted, woollen, and paper mills; grain, saw, and sundry other mills; bagging factories, roperies, and sail-making establishments; bakeries, distilleries, a brewery, tanneries, &c. There are, besides, chemical works, where sulphate of zinc, sulphate of copper, phosphate of soda, and saltpetre are made. In addition to these industries Greenock carries on a considerable foreign and coasting shipping trade; importing large quantities of sugar, molasses, timber, and grain, and exporting coal, pig-iron, dry-goods, machinery, beer, &c. It has also a large passenger and goods traffic with Belfast, Dublin, Liverpool, &c., and forms a starting-point for travellers to the many localities on the west coast. Passengers by the Anchor Line and other steamers to America usually embark at Greenock, the vessels casting anchor at the 'Tail of the Bank'. The harbours are spacious, and possess every accommodation for shipping, including five graving-docks, hydraulic and steam cranes, &c. The quays can be approached by steamers at any state of the tide, and vessels of the largest class enter the harbours. The total number of vessels entered in 1899 was 8960 of 1,693,010 tons, of which 8525 were steamers of 1,625,288 tons; cleared, 9373 vessels of 1,856,917 tons. The value of foreign and colonial produce imported in 1889 was £3,879,804, in 1899, £1,161,169; the exports are comparatively small.

Greenock was erected into a burgh of barony by a grant of Charles I. to Johne Schaw, of Greinocke, and Helen Houston, his spouse. In 1670 a new charter grants an indemnity for building a harbour (an encroachment on the right of the crown to the ground between the ebb and flow of the tide), and authorizes the maintenance of a free harbour. An application was made to the Scottish Parliament in 1692 by Sir John Shaw for assistance to build an efficient harbour, but it was ordered to lie on the table. In 1703 Sir John Shaw, son of the above-mentioned baronet, induced the inhabitants to agree to a voluntary assessment for the construction of a harbour, which was begun on this footing, and after many alterations completed in 1734. In 1710 Greenock was made a custom-house port. In 1751 an act of Parliament was obtained levying a local tax of two pennies Scots for every Scots pint of beer brewed or sold in the town, to be paid to trustees, for building, repairing, and deepening the harbours. The tax was levied for thirty years. In 1773 an act of Parliament was obtained for deepening, cleansing, and making more commodious the harbour of Greenock. Up till recent times there were four harbours, the principal of which were the Victoria and Albert harbours, the two having together a water area of about 17 acres; but great extensions have since taken place, the most recent addition being the James Watt Dock, with a water area of 14½ acres, a total length of 2000 feet, a breadth of 300 feet for half its length, the other half being 350 feet; it has a jetty of 806 feet long and 90 broad; the depth of water in it is 32 feet, amply sufficient for the largest class of vessels. Two tidal harbours and other extensive auxiliary works have also been projected. Greenock sends one member to Parliament. Pop. in 1881, 66,704; in 1891, 63,423; in 1901, 68,142.

GREENOCKITE, native sulphide of cadmium (CdS), a mineral first found in the Bishopton railway cutting in Renfrewshire, and named after Lord Greenock. It is the only separate ore of cadmium, and is of very rare occurrence, having been found in only one or two other localities. Its crystals are hexagonal, they have a yellow, orange, or brown colour, and are translucent and doubly refracting, and have a somewhat resinous lustre. Specific gravity, 4·9; moderately hard. When heated it decrepitates and becomes red; dissolves readily in hydrochloric acid, and is easily decomposed by heating on charcoal.

GREEN PAINTS. Green paints and pigments differ in composition according to the purpose for which they are used. Thus, the green colours for porcelain are very different from those used in oil-painting. The chief colouring materials employed are compounds of copper and chromium, while the different shades are produced by mixture, but sometimes unaccountably by slight modifications in the process. The following are some of the colours:—

Bremen green, or verditer, is prepared in various ways, but seems to consist mainly of a basic carbonate of copper. *Brunswick* green is a hydrated oxychloride of copper; but the name is now generally applied to a mixture of Prussian blue, chrome yellow, and barytes. *Chrome* and *emerald* green are oxide of chromium, got by precipitation or by ignition of a readily decomposable chromate. *Emerald* green (which see) is also used as synonymous with *Schweinfurt* green. *English* green is a mixture of Scheele's green with gypsum. *Guignet's* green is oxide of chromium prepared in a peculiar way. *Hungary* green is a kind of malachite found in Hungary. *Rinman's* green is the colour got by heating zinc oxide with a cobalt compound. *Saxony* green is an indigo colour used in printing. *Scheele's* green is arsenite of copper. Besides this compound there are others which contain arsenic and copper; for example *Schweinfurt* green, *Veronese* green, *Vienna* green. *Verdigris* is a basic acetate of copper which forms on the surface of copper plates, when exposed to the action of vinegar or pyroligneous acid. Besides these are green colours derived from plants. Of these may be mentioned *chlorophyll*, the green colour of leaves; *sap* green, the juice of *Rhamnus catharticus* or buck-thorn, made into a green lake with alumina; *Chinese indigo-green*, which is employed in Europe for dyeing silk various tints; and the numerous combined colours got by mixing blues and yellows in various proportions, sometimes with the addition of other matters.

GREEN RIVER, a river of the United States, Kentucky, flows generally west and north-west, and enters the Ohio 200 miles below Louisville. It is 200 yards wide at its mouth, and is navigable for boats for about 200 miles.

GREENS, a common name given to various species of green vegetables used for table, as open-leaved cabbage, spinach, &c.

GREENSAND, a name given to two divisions of the cretaceous formation. See GEOLOGY.

GREENSHANK (*Totanus glottis*), a bird of the order Grallatores, belonging to the Snipe family. It is found in the coast districts or about lakes and marshes in Great Britain and Ireland, occurring mostly as a visitor, and going farther north to breed and farther south for its winter residence. It breeds pretty commonly in the Hebrides, and sometimes in the north of Scotland. It feeds on small fish, worms, insects, crustacea, and mollusca. It is a shy and wary bird, seldom allowing itself to be approached within gunshot. The nest, as described by Macgillivray, is merely a cavity scraped in the turf and lined with some twigs of heath and blades of grass. The eggs are four in number. The whole length of the bird is about 12 inches. The beak is black, and slightly curved upwards; the upper part of the head,

and back part and sides of the neck, are marked with dark lines on a grayish-white ground; the back, wing-coverts, and tertiaries are ash-brown, edged with buffy white; primaries dusky black; tail-feathers white, with brown bars and stripes; breast and under parts white, legs and toes olive-green, claws black.

GREENWICH, a mun. and parl. bor. of England, county of London, on the right bank of the Thames, about 5 miles S.E. of London Bridge. It is built partly on an acclivity, but chiefly on the level ground skirting the Thames. The few old streets which now remain are mostly situated near the river side, and are narrow, irregular, and mean in appearance; but numerous new streets of artisans' dwellings have been erected both in East and West Greenwich. Not much of the marsh land of East Greenwich has yet been built on, as the locality is below the level of high-water mark. Greenwich contains several handsome churches, one of which, the parish church of St. Alphege, was erected in 1718 out of Queen Anne's Bounty. There are also two fine Roman Catholic chapels and several places of worship for dissenters. The town is rich in charitable and educational establishments, among which the chief are Queen Elizabeth's College, founded in 1576, the first of its kind established subsequently to the Reformation; Trinity Hospital, or Norfolk College (founded 1613), for the support of a warden and 20 pensioners; Morden College (erected 1695), for the support of decayed merchants; the Jubilee almshouses, dating from 1809, but rebuilt in 1887, &c. There are extensive iron-foundries and engineering works, barge and boat building yards, boiler-works, mast, block, and sail works, telegraph-cable works, roperies, chemical factories, &c. Greenwich Park, an open, undulating piece of ground behind the town, area 180 acres, is finely wooded, well stocked with deer, and, having a diversified surface, its appearance altogether is exceedingly picturesque. It is a favourite resort of holiday-making Londoners during the summer months.

The object of greatest interest in Greenwich is its magnificent hospital, which was established for the maintenance of veteran, wounded, or unfortunate seamen, but is no longer used for this purpose. The oldest portion of this noble structure was originally a palace of Charles II., and was erected on the site of the ancient 'Greenwich House', which, so far back as the year 1300, had been a favourite residence of royalty—in which Henry VIII. and his queen daughters, Mary and Elizabeth, were born; and where, too, Edward VI. breathed his last. It was converted to its charitable purpose in the reign of William and Mary, although not opened for the reception of inmates until 1705, when forty-two were admitted. Three additional wings were built from designs by Sir Christopher Wren, under whose superintendence it was carried on, and who also completed the unfinished pile of Charles II. It was finished by his successor, Sir John Vanbrugh. It stands on the bank of the river, on an elevated terrace, 865 feet in length, and covers, with the schools, civil offices, lawns, and burial-ground attached, a space of 40 acres. It consists of four quadrangular piles, built principally of Portland stone, each bearing the name of the sovereign in whose reign it was erected—namely, King Charles, Queen Anne, King William, and Queen Mary. Two of the wings front the river and two the park. A room in King William's building contains relics of Nelson, and Queen Anne's building has been converted into a naval museum. Greenwich Hospital—still popularly so called—is no longer an asylum for seamen of the British navy, and is now mainly devoted to the higher and scientific education of naval officers, the name of the institution having also been changed to the Royal Naval College. An act of Parliament in 1865 empowered the admiralty to grant outdoor pensions to such of the inmates as were willing to quit the hospital, and about 1000 of the 2700 inmates at once elected to leave on the money allowances offered them; and their example was soon afterwards followed by most of the rest, only about 350, infirm or sick, remaining. Another act (1869) authorized the admiralty to transfer invalids from Greenwich Hospital to naval hospitals or infirmaries, and to substitute pensions in lieu of maintenance in or at the expense of Greenwich Hospital. The complement of in-pensioners used to be over 2500, each of whom, besides clothing, food, &c., received 1*s.* a week as tobacco-money. The income of the establishment is about £170,000, and of course the funds are still available for the pensions of veteran seamen as before. The Royal Naval College was instituted for the education of naval officers above the rank of midshipman in all branches of theoretical and scientific study bearing on their profession, funds being voted by Parliament. The course of instruction at the Royal Naval College is almost wholly mathematical and physical. The examination is in two parts, known as *preliminary* and *further*, the subjects of the former being algebra, geometry, trigonometry, elementary kinematics and kinetics, and those of the latter elementary statics and hydrostatics, physics, the steam-engine, French, winds and currents, practical navigation, nautical astronomy, nautical surveying, instruments, observations, and miscellaneous questions. The officials of the College are a governor, a president, a director of studies, a captain, and a commander, and the staff comprises professors of mathematics, applied mechanics, physics, chemistry, and fortification. Connected with the institution is the Royal Hospital-school for the sons of sailors and petty officers in the navy, for which the school serves as a nursery, only boys fit for a naval life being allowed to go through the whole course.

The celebrated observatory of Greenwich stands upon an eminence in the park. It was erected by Charles II. for Flamsteed, the well-known astronomer. Among other astronomers-royal have been Edmund Halley, James Bradley, Nevil Maskelyne, Sir G. B. Airy, and W. H. M. Christie (still at the head of the institution). The work here performed is principally dedicated to one branch of astronomy—namely, that depending on meridional observations, and the calculations connected with them; latterly, however, meteorology and magnetic phenomena have occupied a considerable share of attention. The 'first meridian' (see MERIDIAN) is that of this observatory, which gives 'Greenwich time' by telegraph to all the rest of the country.

Greenwich sends one representative to Parliament. In 1899 it was created one of the metropolitan municipal boroughs by the London Government Act of that year. Pop. of parl. bor. in 1891, 78,167; in 1901, 95,620; of mun. bor. in 1901, 95,757.

GREGARINÆ, GREGARINIDA, a group of minute parasitic animals belonging to the Protozoa, without mouth or anus, living in the protoplasm of their hosts (all of which are invertebrates), and reproducing usually by spores. The soft protoplasm of the body has only an obscure slightly thickened outer layer, and nourishment is absorbed through this by endosmosis. See PROTOZOA.

GRÉGOIRE, HENRI, COUNT, bishop of Blois, statesman and churchman of the period of the French revolution, born on 4th December, 1750. He was educated for the church, taught at the

college of Mont-à-Mousson, and in 1789 was curé of Emberménil, in the district of Nancy, when the clergy of Lorraine sent him as their representative to the states-general. He had a considerable share in bringing about the union of the three orders, and was among the first of the clergy to take the constitutional oath. He was named one of the secretaries of the constituent assembly, and in the convention he supported the abolition of royalty. He voted for the condemnation of the king, but not for the punishment of death, to which he was opposed from religious principle. He was active in introducing the new educational machinery, and also in advocating the abolition of colonial slavery, decreed by the convention in February, 1794. He was a member of the Council of Five Hundred, of the corps législatif, and of the senate (1801). He was opposed to the concordat, and on its conclusion resigned his bishopric. He voted against the establishment of the imperial government, and alone in the senate resisted the restoration of titles of nobility. He himself afterwards accepted the title of count, but in the senate he was always one of the small body who opposed Napoleon. In 1814 he was one of the first to vote for the deposition of the emperor. After this he remained in retirement, but continued after the restoration to write against the ultra-royalists. He died at Paris, 28th May, 1831. He left numerous works, among them Ruines de Port Royal; Essai Historique sur les Libertés de l'Eglise Gallicane; Histoire des Sectes Religieuses depuis le Commencement du Siècle dernier jusqu'à l'Époque actuelle; Annales de la Religion.

GREGORIAN CALENDAR. See CALENDAR.

GREGORIAN LITURGY, the ritual which Pope Gregory I., surnamed *the Great*, introduced after 590 in the Church of Rome in the administration of the Eucharist, as exhibited in the book entitled Gregorianum Sacramentarium. St. Gregory made a new arrangement of the liturgy of Gelasius, which was previously in use, expunging from it what seemed to him useless and adding a very few new prayers. The celebration of the mass is still essentially the same as it was then settled. Not contented with modifying the liturgy, Gregory also regulated the chants. St. Ambrose, whose collection of chants had long been in use before that of Gregory's, had carefully avoided the use of melodies adopted by paganism, but Gregory did not scruple to introduce such airs. (See next article.) All the churches did not at first adopt Gregory's liturgy; the Ambrosian is still retained at Milan.

GREGORIAN MUSIC, the church music as perfected by Gregory the Great, and still generally prevalent; also known as *Plain Song*. The modern tonal system in music consists of twelve scales, or keys, as they are called, each scale being a succession of seven sounds, rising at proportionate intervals, and forming, with the repetition of the first doubled in pitch, an octave. The same proportionate sounds are repeated through successive octaves (whether rising or falling) as far as the powers of the instrument or the sense of distinguishing sounds will permit. The twelve keys are also related to each other by certain proportionate intervals, and arise out of each other in a natural order of succession in each octave, the fourth or fifth of one scale forming the first of another, and so on, until, the succession being exhausted, the scale returns to the original key.

This system, though based on natural principles of key-relationship, is purely artificial, as far as the limitation to a fixed number of keys, and the return of the scale after a limited number of changes to its original starting-point, are concerned. The natural order of progression is apparently infinite, and it is limited by the principle called *temperament*, which consists in making at certain stages of the progression two distinct, though nearly approximate intervals to be represented by a single interval. By this means the succession of sounds is constantly made to recur to one of the twelve original starting-points instead of having an indefinite number of new ones. The modern tonal system is of recent growth, and until it was invented and perfected by the system of equal temperament the subject of tonality was a constant source of embarrassment to musicians. Even the natural principle of key-relationship on which it is founded has only been practised for about two centuries, not being recognized even by Palestrina. (See MUSIC.)

In the early ages of church music the Greek system of tetrachords was followed. There were in the time of Ambrose of Milan fifteen so-called Greek modes or scales in use. In order to simplify church music he selected four of these scales, the Dorian, Phrygian, Æolian, and Mixo-Lydian, to which he attempted to reduce all the chants and melodies sung in church. This selection of scales was soon found to be too limited. The church singers refused to be bound to it, and it failed to represent the melodies actually in use. In these circumstances Pope Gregory the Great (590–604) introduced a reform and extension of church music. To each of the scales admitted by Ambrose he added a new scale or mode, commencing with the fourth below the key-note of the original scale. These new scales he called *plagal*, while to the four introduced by Ambrose he gave the name of *authentic*. He also introduced the practice of naming the tones by the letters of the alphabet. The following is the arrangement of his eight scales:—

1st. Authentic (Dorian), ...	D	E	F	G	A	B	C	D
2nd. Plagal, ...	A	B	C	D	E	F	G	A
3rd. Authentic Phrygian,.....	E	F	G	A	B	C	D	E
4th. Plagal,.....	B	C	D	E	F	G	A	B
5th Authentic Æolian,..	F	G	A	B	C	D	E	F
6th. Plagal,..	C	D	E	F	G	A	B	C
7th. Authentic, Hyper-Dorian or Mixo-Lydian,..... .	G	A	B	C	D	E	F	G
8th. Plagal,.....	D	E	F	G	A	B	C	D

The scale of C, with the semitones between the 3rd and 4th, and the 7th and 8th, which in the modern system is called the natural scale, and is the pattern on which all the others are formed, was thus, it will be seen, one of the plagal scales introduced as an innovation by Gregory. The fixed position of the semitones, which forms the essential distinction of modern tonality, was entirely unknown to the Gregorian. There were, however, some positions in which they were found objectionable and rejected. According to modern notions the eight modes of Gregory, or the fourteen possible modes of the old tonality, would (except for the introduction of accidental sharps and flats) be all considered as in one scale, but they are distinguished, as the melodies constructed in them show, by other tones being used as key-notes besides that now considered as the natural key-note. There are in modern music in this sense only two modes, the first beginning with the natural key-note, called the major mode, the other with the third below or sixth above the key-note, called the minor mode.

GREGORY, Bishop of Neocæsarea, in which place he was born about 210, of pagan parents, was called, on account of the miracles which he is said to have performed, *Thaumaturgus* ('wonder-worker'). He died about 270. He was distinguished for his eloquence, and was a pupil of Origen, on whom he wrote a Panegyricus. We have also a Confession of Faith by him and some pieces of doubtful authenticity. His writings are in Migne's Patrologia.

GREGORY OF NAZIANZUS (*Gregorius Nazianzenus*), Bishop of Constantinople, a father of the Greek Church, was born at Arianzas, a place near Nazianzus, in Cappadocia, about 330. He studied at Alexandria and subsequently at Athens, where he became the friend of Basil, and made the acquaintance of Julian, known to after-times as the Apostate. Receiving baptism, he retired for some time with St. Basil to Pontus. He began to preach in 362. Between 365 and 374 he exercised his vocation chiefly at Nazianzus, assisting his father during the latter part of the period in the administration of the diocese, of which he was bishop. He went to Constantinople about 378 or 379 to oppose the Arians, and was appointed patriarch of that see by Theodosius in 380. The election was confirmed by the Council of Constantinople in 381, but during this same year he resigned and retired to his former charge of Nazianzus. He died in 389 or 390. We possess a number of sermons by him, a large number of letters, and many poems; the last are of very mediocre character, but the letters are interesting and valuable. The best complete edition of his works is that of the Benedictines (vol. i. 1778; vol. ii. 1840), edited by Clemencet and Caillou. His eloquence is said to have placed him nearly on a level with Basil and Chrysostom. His festival is celebrated on 9th May.

GREGORY OF NYSSA, a father of the Greek Church, brother of St. Basil, was born at Sebaste, Pontus, about 332; died about 398. By his brother's influence he was made Bishop of Nyssa, in Cappadocia. He took a prominent part in the Councils of Constantinople from 381 to 394. He was less distinguished as an orator than Gregory of Nazianzus, but was more distinguished than any of the Greek fathers for a philosophical spirit, and for his acquaintance with the writings of the Greek philosophers. He also exhibited a liberality in his views uncommon in his day. His festival is on 9th March. His works consist of dogmatic treatises, Scripture commentaries, sermons, letters, &c. One of the best editions is that of Paris, 1615, with a Latin version.

GREGORY OF TOURS (*Gregorius Florentius*), historian of Gaul, was born in Auvergne according to some in 539, according to others in 544. He died at Tours in 594. He belonged to an illustrious family, but owing to the disturbed state of the country received only an imperfect education. After receiving orders he lived some time at the court of Austrasia, and was elevated to the bishopric of Tours, which was almost an appanage of his family, in 573. He had the courage to oppose Chilperic and Fredegonde in their violent courses, and incurred the implacable hostility of the latter. He acted the part of a peace-maker in the dynastic quarrels of the period, and contributed to the conclusion of the Treaty of Andelot in 588. His Historia Francorum, though destitute of style or method, contains an invaluable collection of facts bearing on the manners of the Franks and Gallo-Romans, and the historical events of the period, and has caused him to be ranked as the Herodotus of Gaul. He also wrote lives of fathers, ecclesiastics, and martyrs, &c. His complete works are contained in Migne's Patrologia (vol. lxxi.), and his history is included in the first volume of the Monumenta Germaniæ Historica (1884–85).

GREGORY I., pope, called also the *Great*. He was born at Rome, of a noble family, about 540; and having received an education suitable to his rank, he became a member of the senate, and filled other employments in the state. Justin II. appointed him to the important post of prefect or governor of Rome, which he resigned after having held it for some time with great reputation. The death of his father put him in possession of great wealth, which he expended in the foundation of monasteries and charitable institutions. Disgusted with the world, he took the monastic vows himself, and became a member of one of his own establishments. Pope Pelagius II. sent him on an embassy to Constantinople, and made him Papal secretary after his return to Rome. On the death of Pope Pelagius in 590 he was chosen his successor, an honour which he very unwillingly accepted. He displayed great zeal for the conversion of heretics, the advancement of monachism, and the rigid enforcement of celibacy among the clergy; and there was nothing in which the church was concerned that he deemed too small to lie beyond the sphere of his personal interest and action. (See GREGORIAN LITURGY, GREGORIAN MUSIC.) His contest for ecclesiastical superiority with John, patriarch of Constantinople, contributed to bring about the schism between the Greek and Latin Churches (see GREEK CHURCH.) The conversion of the Anglo-Saxons to Christianity was a project honourable to his zeal and abilities. (See AUGUSTINE, ST.) He died in March, 604. The works ascribed to this pope are very numerous, and have been frequently published. The most complete edition is that of the Benedictines of St. Maur (Paris, 1705, four vols. folio), under the superintendence of Father Denis de St. Martha, who, in 1697, published a life of St. Gregory the Great. His genuine writings consist of a treatise on Pastoral Duty (translated by King Alfred), Letters, Scripture Commentaries, &c.

GREGORY VII. (*Hildebrand*), one of the most distinguished popes, was of humble birth, and was born about 1015. Little more is known with certainty of his origin or early career, He is said to have been the son of a carpenter of Soana, in Tuscany. He passed a part of his early life in Rome, and became a monk at Cluny. When Bruno, Bishop of Toul, was elected pope by the emperor and diet in 1048 Hildebrand accompanied him to Rome, having persuaded him, it is said, to lay aside the insignia of the pontificate until he should receive the free suffrages of the clergy and people of Rome. Henceforth Hildebrand became the ruling spirit of the papacy. Leo IX. (Bruno) and his successors, Victor II. (1055), Nicholas II. (1058), Alexander II. (1061), confided in his counsels. He influenced the election of several of these popes, and procured the expulsion of the Anti-popes Benedict and Honorius, who were opposed to Nicholas and Alexander. Under Nicholas II. he succeeded in changing the mode of election to the pontificate. Hitherto the clergy and people of Rome had a voice in the election. He gave the power of nomination to the cardinals alone, leaving the clergy and people only a right of concurrence, of which they were subsequently deprived. This mode of election was in accordance with the ambitious views of universal sovereignty which he had adopted for the papacy. On the death of Alexander II. (1073) Cardinal Hildebrand was raised to the Papal chair. He now laboured with the greatest energy to accomplish those plans for which he had prepared the way by the measures which the preceding popes had adopted through his influence. It was the object of his ambition not only to place the whole ecclesiastical power in the hands of the pope, but to make the church entirely independent of the temporal power. He wished to found a theocracy in which the pope, the vicar of God, should be the sovereign ruler, in political as well as ecclesiastical matters—a bold idea, which he probably conceived in consequence of the wretched state of all civil authority. He therefore prohibited the marriage of priests, and abolished lay investiture, the only remaining source of the authority of princes

over the clergy of their dominions. In 1074 he issued his edicts against simony and the marriage of priests, and in 1075 an edict forbidding the clergy, under penalty of forfeiting their offices, from receiving the investiture of any ecclesiastical dignity from the hands of a layman, and at the same time forbidding the laity, under penalty of excommunication, to attempt the exercise of the investiture of the clergy. The Emperor Henry IV. refused to obey this decree, and Gregory took advantage of the discontent excited by the despotic character of the emperor among the people and princes of Germany to advance his own purposes. In 1075 he deposed several German bishops who had bought their offices of the emperor, and excommunicated five imperial councillors who were concerned in this transaction; and when the emperor persisted in retaining the councillors and supporting the bishops the pope, in 1076, issued a new decree summoning the emperor before a council at Rome, to defend himself against the charges brought against him. Henry then caused a sentence of deposition to be passed against the pope by a council assembled at Worms. The pope, in return, excommunicated the emperor, and released all his subjects and vassals from their oath of allegiance. The emperor soon found all Upper Germany in opposition to him, at the very moment that the Saxons in Lower Germany renewed the war against him; and when the princes assembled at Oppenheim came to the determination of proceeding to the election of another emperor, he yielded almost unconditionally; he was obliged to consent to acknowledge the pope, whom they were to invite into the empire, as his judge, to abandon his excommunicated councillors, and to consider himself as suspended from the government. To prevent being deposed by the pope, Henry hastened to Italy, where he submitted at Canossa (1077) to a humiliating penance, and received absolution. In the meantime his friends again assembled round him, and he defeated his rival, Rodolph of Suabia, who was supported by the pope. He then caused the pope to be deposed by the Council of Brixen, and an anti-pope, Clement III., to be elected in 1080, after which he hastened to Rome and placed the new pope on the throne. Gregory now passed three years as a prisoner in the castle of St. Angelo, but could never be induced to compromise the rights of the church. He was finally liberated by Robert Guiscard, a celebrated Norman prince, whom he had made Duke of Apulia; but the Romans compelled him to quit the city, because it had been plundered by the soldiers of Robert. Gregory then retired to Salerno, under the protection of the Norman prince, where he died in 1085. The character of Gregory was ardent and uncompromising. In the pursuit of his favourite schemes he spared neither friend nor foe. The long dispute he began with Henry IV. about investitures survived both pope and emperor. (See INVESTITURE.) The same subject involved him in disputes with France and England. He carried out his ecclesiastical reforms with an unbending rigour which amounted to ferocity. He employed the monks to excite the people against the married clergy. Among his early schemes, which circumstances did not allow him to carry out, was the subjugation of the Eastern Church and the inauguration of the Crusades. He held openly that spiritual authority was superior to temporal, and implied necessarily a sovereignty over it, and he aimed at nothing short of a universal theocracy in which the clergy, forming a class apart and subject to the pope, should rule despotically the other orders of society. Part of his plans have resulted in maintaining the papacy for centuries in an attitude of antagonism to civil control in ecclesiastical affairs. His pride was shown in the humiliation he inflicted on Henry IV. in 1077, when the emperor was obliged to come as a suppliant to the gate of the fortress of Canossa, belonging to Matilda, countess of Tuscany, an ardent supporter of the pope. He had to remain three days barefooted and in a woollen shirt, fasting and praying from morning to night in the outer court of the castle. Gregory's inflexibility was equally exhibited in the closing scenes of his life, when misfortune overtook him. To the last he refused to withdraw the excommunications he had launched against the emperor, the anti-pope, and their adherents. The words which have been put into his mouth in dying, whether authentic or not, do no injustice to his inflexible spirit, 'I have loved justice and hated iniquity; therefore I am left to die in exile'. It says much for the quality both of the civil and ecclesiastical government of the day that the pope found his chief adherents in Germany, the emperor in Italy.

GREGORY XIII. (*Ugo Buoncompagno*), Roman pontiff, born at Bologna in 1502, was created a cardinal in 1565, and chosen successor of Pius V. in the popedom in 1572. He followed the policy of his predecessor in endeavouring to unite the Christian powers against the Turks, but without success. He also displayed his zeal against the Protestants; permitted the Cardinal of Lorraine to make a public demonstration of thanksgiving for the massacre of St. Bartholomew (but it has been said that he was deceived as to the character of the event), encouraged plots against Queen Elizabeth, and incited Philip II. to attack her. His foreign policy cost him much money for subsidies to excite enemies to the Turks and heretics. He adopted financial expedients to fill his exchequer which ruined the trade and disturbed the peace of his own dominions. He deprived the Venetians of the privilege of exporting grain from the March and Ravenna, and revoked the fiefs of the Roman nobility, who rose in insurrection, but instead of attacking the government, contented themselves with pursuing their party feuds, so that all the provinces of the state were delivered over to brigandage. On the other hand, he did much for the promotion and encouragement of education; his expenditure for this purpose exceeded two million Roman crowns, out of which many of the colleges of Rome were either wholly or partially endowed. Gregory is chiefly celebrated for the reform of the calendar with which his name is associated. (See CALENDAR.) He died 10th April, 1585.

GREGORY, DAVID, mathematician, was born at Kinnairdie, Banffshire, on 24th June, 1661, and educated at Edinburgh, where, in 1683, he was elected professor of mathematics; and the same year he published a mathematical treatise from his uncle, James Gregory's, papers, with important additions of his own. His lectures first introduced into the schools the Newtonian philosophy. He went to London and received an introductory letter from Sir Isaac Newton to Flamsteed, the astronomer-royal, and by their influence he was in 1691 chosen Savilian professor of astronomy at Oxford, for which appointment he was a competitor along with Halley, with whom he afterwards maintained a friendly intercourse. He was elected a member of the Royal Society; and took the degrees of M.A. and M.D. at Oxford. In 1695 he published at Oxford Catoptricæ et Dioptricæ Elementa, in which he considers those branches of optics chiefly as respects the construction of telescopes, particularly those of his uncle and Sir Isaac Newton. In 1697 he gave the first demonstration of the properties of the catenarian curve; and in 1702 appeared his most celebrated production, Astronomiæ Physicæ et Geometricæ Elementa. The object of this work is to explain Newton's geo-

metry of centripetal forces, as far as his discoveries are founded on it; and to exhibit in a more familiar form the astronomical part of the Principia. In 1703 he published an edition of the books of Euclid in Greek and Latin; and he afterwards engaged with Dr. Halley in editing the Conics of Apollonius. He died at Maidenhead, Berkshire, on Oct. 10, 1708.

GREGORY, JAMES, a mathematician and philosopher, the inventor of the reflecting telescope, was born at Drumoak, in Aberdeenshire, in 1638, and received his education at the Marischal College. In 1663 he published Optica promota, seu abdita Radiorum reflexorum et refractorum Mysteria geometrice enucleata (4to), explaining the idea of the telescope which bears his name; and in 1664 visited London for the purpose of perfecting the mechanical construction of the instrument. Disappointed by the difficulty of getting a speculum ground and polished of a proper figure, he suspended his design, and set off on a tour to Italy. He stayed some time at Padua, where he published in 1667 a treatise on the Quadrature of the Circle and Hyperbola (reprinted at Venice, in 1668, with additions). On his return to England he was chosen a fellow of the Royal Society, whose Transactions he enriched by some valuable papers. He was chosen professor of mathematics in the University of St. Andrew's in 1668, and in 1674 was invited to fill the mathematical chair at Edinburgh, whither he removed; but in October, 1675, while pointing out to his pupils the satellites of Jupiter, he was struck with total blindness, and died a few days after, in the thirty-seventh year of his age.

GREGORY, JAMES, M.D., an eminent physician, eldest son of John Gregory, M.D., was born at Aberdeen in 1753. On his father succeeding Dr. Rutherford as professor of the practice of physic in Edinburgh University, he removed along with the family thither, adopted the paternal profession, and in 1774 took his degree of Doctor of Medicine. So prominently had he distinguished himself, that in 1776, when he was only twenty-three, he was appointed professor of the institutes of medicine. Several years afterwards he gave to the world his celebrated Conspectus Medicinæ Theoreticæ (1780–82), which continues to the present day a text-book for medical students. In 1790 he succeeded Dr. Cullen as professor of the practice of physic, and in 1792 appeared his Philosophical and Literary Essays. For a period of nearly fifty years he enjoyed the most extensive and lucrative practice in Scotland as a physician. Though somewhat rough and unceremonious in his manners, he possessed one of the soundest of judgments, and was thoroughly conversant with all the details of medical science. His conversational powers were famed throughout Edinburgh society, and as a writer of Latin prose no modern scholar has surpassed him for elegance and perspicuity. He died on 2d April, 1821.

GREGORY, JOHN, M.D., a distinguished physician, was a son of James Gregory, professor of medicine in King's College, Aberdeen, and a grandson of James Gregory, the celebrated inventor of the reflecting telescope. He was born on 3d June, 1724, and was educated first at Aberdeen, and afterwards at the universities of Edinburgh and Leyden. On his return from the Continent he was appointed professor of philosophy in King's College, Aberdeen, where he lectured for several years on mathematics and moral and natural philosophy, and then resigned (1749), from a desire to devote himself to the practice of medicine. Three years afterwards he married a daughter of Lord Forbes. He went to London in 1754, and in 1756 he was chosen successor to his elder brother James in the chair of medicine in King's College, which his father had also filled. In this office he remained for eight years, and then removed to practise as a physician in Edinburgh, where, in 1766, he succeeded Dr. Rutherford as professor of the practice of physic in the university, and during the same year was appointed first physician to the king for Scotland. He expired suddenly of gout, a disease which he had inherited from his mother, being found dead in his bed on the morning of 10th February, 1773. Dr. Gregory is well known in literature as the author of A Father's Legacy to his Daughters, a work written by him after the death of his wife for the amusement of his solitary hours, and also by a series of lectures which he published on the Duties and Qualifications of Physicians. He was a friend of Dr. Beattie, who laments his death in the closing verses of the Minstrel.

GREGORY, OLINTHUS GILBERT, was born at Yaxley in Huntingdonshire on the 29th of January, 1774. At the early age of nineteen he commenced his career as an author by the publication of an elementary work entitled Lessons, Astronomical and Philosophical. His thoughts were shortly afterwards turned to the church, but under the influence of some scruples, which led him ultimately to become a Baptist, he abandoned the idea, and, instead of entering the university, he became sub-editor of a newspaper in the town of Cambridge. This employment he soon exchanged for that of bookseller, which was also laid aside on discovering that by teaching mathematics, for which he had a decided turn, he could at once gratify his natural taste and employ his time to greater profit. In 1802 he became mathematical master in the Royal Military Academy at Woolwich, and in 1807 obtained the mathematical chair there. In the former year he published a treatise on astronomy, and the following year undertook the editorship of a kind of dictionary of arts and sciences under the title of Pantologia. In connection with the institution at Woolwich he published several mathematical works, of which his Treatise on Mechanics is the one by which he is best known in the scientific world. It is, however, on two other works of a more popular character that his fame now chiefly rests; the one, Letters on the Evidences and Doctrines of the Christian Religion (1810), and the other, a Life of the Rev. Robert Hall (1833), prefixed to an edition of the collected works of that distinguished preacher. The degrees of M.A. and LL.D. were successively bestowed on Mr. Gregory by Marischal College, Aberdeen. He died on the 2d of February, 1841, at the age of sixty-seven.

GREGORY, WILLIAM, was born at Edinburgh, December 25, 1803, and was son of Dr. James Gregory, the author of the famous Conspectus Medicinæ. After taking his degree he devoted himself to chemistry, went to Giessen in 1835, worked with Liebig for some time, and in 1837 was appointed to the chair of chemistry in Anderson's Institution in Glasgow. This post he held for a couple of years, was thereafter appointed professor of chemistry in Aberdeen, and again visited Liebig's laboratory in 1841. In 1844 he obtained the professorship in Edinburgh, and thereafter resided in Edinburgh till 1858, in the April of which year he died at the early age of fifty-five. He is the author of a considerable number of papers, most of which deal with various organic substances; and he also wrote a text-book, which in many respects is well done, and was especially distinguished by the pains he took to propagate in it Liebig's views and discoveries. He translated several of the writings of this latter chemist, and in his own organic text-book entirely followed the theory of compound radicals. Towards the end of his life he spent a good deal of time upon microscopic work and upon animal mag-

netism, translating into English the work of Reichenbach, and chemistry was comparatively neglected.

GREGORY'S MIXTURE, a popular stomachic and aperient medicine, consists of two parts of rhubarb, four of calcined magnesia, and one of ginger. It is good for occasional use, but should not be taken systematically, as too much magnesia is apt to form concretions in the bowels.

GREIFENBERG, a town of Prussia, in the province of Pomerania, 41 miles N.E. of Stettin, on the left bank of the Rega. It is an old place, having been founded in 1262, and was one of the Hanse towns. Pop. (1895), 5490.

GREIFENHAGEN, a town of Prussia, in the province of Pomerania, in the government and 11 miles S. by W. of Stettin, on the right bank of the Reglitz (an arm of the Oder). It has a church of the 13th century and a tower of the 15th, is the seat of a law-court and several public offices; has manufactures of woollen cloth, leather goods, &c. Pop. (1895), 6798.

GREIFSWALD, a town of Prussia, in the province of Pomerania, on the navigable river Ryck, which about 3 miles farther down enters the Greifswald Bodden, a bay of the Baltic, where is an outer harbour at Wiek. It was early a fortified place, but pleasant promenades now occupy the place of its fortifications. Its streets are mostly broad and straight, and its houses to some extent of a mediæval aspect. It contains three old churches, a university founded in 1456, attended by between 700 and 800 students, and occupying buildings mostly erected between 1856 and 1897, the library being possessed of about 140,000 vols.; a gymnasium, ecclesiastical seminary, and several other schools; a theatre, hospitals, and other benevolent institutions. It has important railway works, and manufactures of machinery, agricultural implements, &c., and a considerable shipping trade. Greifswald was one of the Hanse towns about 1270. Pop. (1885), 20,345; (1895), 22,777; (1900), 22,950.

GREIZ, a town of Germany, capital of the principality of Reuss-Greiz, in a valley on the right bank of the White Elster, 16 miles south of Gera. It is well built, and has, in addition to an old castle, finely situated on a height, the modern residential palace of the prince, with a fine park; a Gothic townhouse, various handsome buildings, monuments to Bismarck and the Emperor William I.; a theological and normal seminary, a gymnasium, &c. It is an important centre of the woollen manufacture in various branches (especially worsted spinning and weaving), carried on both in the town and neighbourhood. Pop. (1895), 22,296; (1900), 22,346.

GRENADA, one of the British West India Islands, the most southerly of the Windward group, 90 miles north of Trinidad. It is 21 miles long and 12 miles broad; area, 133 square miles. Grenada is one of the most beautiful of the West India Islands, rugged and picturesque in the interior, which is occupied by an irregular mass of volcanic mountains attaining elevations of 3000 and 3200 feet above sea-level, and from which hills of less height branch off. Between these lie valleys containing tracts of great fertility. On the south-east coast there is a considerable extent of low, swampy ground, rendering this locality extremely unhealthy, particularly in autumn. In the centre of the island, about 1700 feet above sea-level, there is a circular lake, 2½ miles in circumference, inclosed by lofty mountains. Rivers and rivulets are extremely numerous. The climate is oppressively hot in the low lands, though greatly tempered by the sea-breeze; but cool and pleasant on the hills. It is healthy on the whole, so much so that Grenada is visited as a health-resort by many of the residents of Trinidad. The average temperature is about 80°; the rainfall about 82 inches. Sugar was formerly the chief article of cultivation, but at present cocoa stands by far the first among the exports, others being nutmegs and other spices, fruits, sugar, &c. Fishing is carried on to a small extent. The imports average about £165,000, and the exports £170,000 per annum. The island is under the governor of the Windward Islands (which include also St. Lucia and St. Vincent). There is a legislative council for the island of six official and seven unofficial members. The capital is St. George's. Grenada was discovered by Columbus in his third voyage in 1498, at which time it was inhabited by Caribs, who were subsequently exterminated by the French, by whom the island was colonized, about the middle of the seventeenth century, and in whose possession it remained till 1762, when it was taken by the British. It was captured by the French in 1779, and restored to Britain in 1783. Pop. in 1881, 42,403; in 1901, 65,523, of whom about 1000 were whites.

GRENADE, a small hollow ball, cylinder, or cube, of metal, glass, or paper, about 2½ inches in diameter, which is filled with some explosive, and bursts by means of a fuse when it falls among the enemy. Until about the end of the seventeenth century trained soldiers called *grenadiers* threw grenades by the hand. (See GRENADIER.) Grenades have been delivered from mortars, wooden shoots, &c., to repel the close attacks of besiegers sheltering themselves under the besieged walls. They have been found useful also in repelling boat attacks. At the siege of Mafeking in 1899–1900 dynamite grenades are said to have been thrown by the besieged. Grenades were one of the earliest forms of explosive projectiles. The gradual disuse of hand-grenades dates from the battle of Steinkerque in 1690.

GRENADIER, originally a soldier destined to throw the hand-grenade. (See GRENADE.) Soldiers of long service and acknowledged bravery were selected for this service, so that they soon formed a kind of *élite*. There were at first only a few grenadiers in each regiment. Companies of grenadiers were formed in France in 1670, in England a few years later. Hand-grenades soon gave place to the musket, and the name then became only a *souvenir* of the ancient practice. The troops so called were distinguished by the height of the men and a particular dress, as, for instance, the high bear-skin cap. In the British army there was long a grenadier company in each regiment; but the name is now retained only as that of the first three battalions of foot-guards, who are designated Grenadier Guards. See GUARDS.

GRENADINES, a chain of small islands and rocks in the West Indies, between the islands of Grenada and St. Vincent, forming dependencies of those islands. The two principal islands, Carriacou and Becouya, are inhabited, and produce coffee, indigo, cotton, and sugar. Pop. about 3000.

GRENOBLE (Latin, *Gratianopolis*), a strongly-fortified town of France, capital of the department of Isère, in a fertile, well-watered, and well-wooded basin, surrounded by lofty mountains belonging to the Alps of Dauphiny, on the Isère, above the entrance of the Drac, 60 miles south-east of Lyons. It consists of two parts, separated by the river, which is crossed by several bridges and lined with fine quays. The main portion of the city is on the left or south bank. It possesses fine public gardens, and handsome squares with various monuments. Among buildings may be mentioned the cathedral, partly modern, in part dating back to the eleventh century; the old church of St. Laurence; a valu-

able public library of 172,000 volumes and 7300 manuscripts; the college, or school of medicine and pharmacy; the museum; the bishop's palace; Palais de Justice, or the court-house (1897); the theatre; the arsenal. The principal manufacture is that of kid gloves, which employs over 20,000 hands in the town and neighbourhood; linen goods and fine liqueurs are made; and there are also tanneries, and works for the carding of hemp, which is largely exported. Grenoble is the see of a bishop, and the seat of departmental and other courts; and has a university college, lyceum, normal-school, a school of design, &c. It existed in the time of Cæsar, but never acquired much importance under the Romans; though Gratian, who had improved it, withdrew its ancient name of Cularo, and called it, after himself, Gratianopolis. Its subsequent history possesses little interest. Pop. (1901), 68,615.

GRENVILLE, George, a British minister, younger brother of the first Earl Temple, and father of William Wyndham, the first Lord Grenville (see below), was born in 1712, studied at Oxford, and in 1741 entered Parliament as member for Buckingham borough, which he represented till his death. He became treasurer of the navy in 1754; secretary of state and subsequently Irish lord of the admiralty in 1762; first lord of the treasury and chancellor of the exchequer in April, 1763. In 1765 the Commons accepted his scheme for stamp-duties to be levied in the American colonies, which was one of the proximate causes of the American war of Independence. Soon after, he had to retire from office, and was replaced by Lord Rockingham. In 1766 he defended the stamp act in Parliament; in 1769 he opposed the expulsion of Wilkes from the House of Commons, and in 1770 he brought in the Controverted Elections Bill, which was passed. He died later in the same year. He was able, hard-working, and honest, but narrow-minded and obstinate, wanting in tact and foresight. The Grenville Papers, containing the correspondence of George Grenville with his brother Richard, Earl Temple, edited by W. J. Smith (1852–53), contain interesting information on the politics of the day.

GRENVILLE, Sir Richard, one of England's naval heroes, belonged to an old Cornish family, and was born about 1541, being a cousin of Sir Walter Raleigh. In his youth he appears to have served in Hungary against the Turks; subsequently he was a member of Parliament for Cornwall, and was sheriff of his county in 1577. In 1583 and 1584 he was commissioner for works at Dover harbour. In 1585 he received command of a fleet of seven vessels which took out colonists to Virginia, and on the homeward voyage he captured a Spanish ship of war that had attacked him. Then followed another voyage to Virginia, on returning from which he landed in the Azores and carried off as much plunder and as many Spanish prisoners as he could. In the Armada year (1588) he was diligently employed in taking measures for the defence of the western counties of England. In 1591 he was vice-admiral of a squadron commanded by Lord Thomas Howard which was sent to the Azores for the purpose of intercepting homeward-bound Spanish treasure-ships, Sir Richard himself being in command of the *Revenge*, a ship of 500 tons and 250 men. Suddenly news was brought to the English commander by a fast-sailing pinnace that a powerful Spanish fleet of men-of-war was at hand, and the enemy's ships indeed immediately made their appearance. Howard saw that resistance was hopeless, and forthwith gave the Spaniards the slip. Sir Richard's ship, however, was cut off from the rest of the squadron, either by his own deliberate intention or through some cause of delay. Though the force against him was of course overwhelming, he determined to fight to the last, and it was only after fifteen hours' desperate resistance, when ship after ship of the enemy had been beaten off, crippled, or sunk, and when the *Revenge* itself was reduced to a helpless wreck, that the sorely wounded hero and the remnants of his gallant crew were overpowered and taken prisoners. Sir Richard died two or three days after on board one of the Spanish ships, declaring, 'Here die I, Richard Grenville, with a joyful and quiet mind, for that I have ended my life as a true soldier ought to do, that hath fought for his country, queen, religion, and honour'. The *Revenge* and a number of Spanish ships were wrecked in a great storm that raged within a few days of Sir Richard's death. The heroic exploit of Sir Richard is celebrated in Tennyson's ballad of The Revenge, one of the noblest poems of its class in the English language.

GRENVILLE, William Wyndham, Lord, third son of the Right Honourable George Grenville, was born 25th October, 1759, and studied at Eton and Oxford. In 1782 he was elected member of Parliament for Buckingham borough. He was secretary for a short time to his brother, Earl Temple, afterwards Marquis of Buckingham, when lord-lieutenant of Ireland, was then appointed paymaster-general of the army, and after being returned in 1784 for Bucks, was appointed a member of the board of control. In 1789 he was elected speaker, and in May of the same year he became secretary of state for the home department. In 1790 he was raised to the peerage as Baron Grenville, and from 1791 till Mr. Pitt's resignation in 1801 he held the post of foreign secretary, and was the chief spokesman of the ministry in the House of Lords. On the return of Pitt to office in 1804 he declined to join him, and continued in opposition till his death, when he became the head of a coalition ministry, including Fox and Grey, in 1806. This ministry resigned in March, 1807, after having passed an act for the abolition of the slave-trade. Lord Grenville did not again take office. He was a supporter of the movement in favour of Roman Catholic emancipation. He died on 12th January, 1834.

GRESHAM, Sir Thomas, a merchant of London, was born probably in 1519, and educated at Gonville and Caius College, Cambridge. His father was a London merchant, and agent of the king's money affairs in the Low Countries; and young Gresham assisted him, latterly becoming himself royal agent or king's merchant at Antwerp. On the accession of Mary he was deprived of his office, in which he had been very successful, but it was soon restored to him, and he was knighted by Elizabeth in 1559. For years he was a most important intermediary in financial affairs carried on between England and the Continent. In 1565 he planned and erected an exchange, for the merchants of London, in imitation of that of Antwerp. In 1571 Queen Elizabeth, visiting the new building, solemnly proclaimed it the *Royal Exchange*. Sir Thomas acquired vast wealth, and repeatedly entertained the queen. In 1575 he founded a college in London, notwithstanding the opposition of the University of Cambridge, and devised his house in Bishopsgate Street for habitations and lecture-rooms for seven professors of the seven liberal sciences, divinity, physic, astronomy, geometry, law, rhetoric, and music, to receive their salaries out of the revenues of the Royal Exchange. The old building has long disappeared. The Gresham lectures, which few or none attend, are still given in a new building, called Gresham College, in Gresham Street, city of London.

The new building was opened in 1843. Gresham died in London, 21st November, 1579.

GRESSET, Jean Baptiste Louis, a French poet, born at Amiens, 1709, entered the order of the Jesuits in his sixteenth year. At the age of twenty-four he produced a small poem full of graceful badinage called Vert Vert, the subject being the adventures of a perroquet of the Visitandines of Nevers. It acquired him a reputation beyond its intrinsic merits. This was followed by other small pieces in a similar style, the Lutrin Vivant, the Carême impromptu, &c. These pursuits being displeasing to the Jesuit fathers he quitted the order and went to Paris in 1735, where he wrote both tragedies and comedies for the theatre. These, with the exception of one comedy, Le Méchant, were not calculated to increase his reputation; which was notwithstanding so great that he was admitted a member of the Academy in 1748. His further literary efforts showed marked evidences of decline, of which he appeared himself to be sensible. He retired to Amiens, married in 1751, and became president of a literary society, which office he resigned in 1759, living afterwards in retirement, and burning some of his manuscripts. He was chosen by the Academy, on the accession of Louis XVI., to congratulate him, and at the same time replied to the inaugural discourses of Alembert and Suard. The public curiosity was excited by the recollection of his former fame, but he singularly failed to justify it, and a painful impression of failure was produced by his attempts to take up his old rôle of a painter of character. Louis XVI. gave him letters of nobility in 1775. He died in 1777. His last years were spent in works of piety and benevolence. It was found after his death that he had been in the habit of providing secretly for many years for the wants of a large number of poor people. Of his literary reputation Villemain says, 'He was only a poet for a short time, it is true, and within a narrow range of subjects, but it was enough, he will live for ever.' Vert Vert has been translated into Italian, German, and Portuguese. The best edition of his works is that of Renouard (Paris, 1811, three vols. in 8vo).

GRETNA GREEN, or Graitney, a village and parish of Scotland, in Dumfriesshire, on the Solway Frith, 8 miles north of Carlisle. It was for nearly a century notorious as the place of celebration of the marriages of fugitive lovers from England. To conclude a lawful marriage in Scotland, it is only necessary for an unmarried couple to go and declare themselves man and wife before witnesses. The English marriage service was usually read at these marriages by a pseudo-priest, said to be the blacksmith of the village, who has become in consequence a historical character in fiction. Gretna Green marriages are now at an end, in consequence of 19 and 20 Vict. cap. xcvi., which enacts that no irregular marriage contracted in Scotland shall be valid, unless one of the parties resides in Scotland, or has done so, for twenty-one days next preceding such marriage. Gretna Green is a station on the Caledonian Railway.

GRÉTRY, André Ernest Modeste, a French composer of music, was born at Liége, 1741. His musical taste showed itself at an early age. In 1759 he went to Rome and received lessons from Casali. He was successful in setting some theatrical pieces to music, which gained him the approval of Picini. After staying some time in Geneva, where he produced a piece called Isabelle and Gertrude in 1767, he visited Voltaire at Ferney, but could not induce him to write a libretto for him. He came to Paris in 1768, and Marmontel wrote for him Le Huron, which was produced in 1769, and proved a success. From this time he produced numerous operas abounding in melody, but meagre in instrumentation. In the latter department of his art he strove in vain to rival Méhul and Cherubini, and his weakness in this respect has prevented his music from becoming popular out of France. His genius was more lyrical than dramatical; and as he affected to despise choral and instrumental effects, he failed to advance with the progress of musical art. His popularity in his own line was, however, great, and honours were heaped upon him. Of his operas may be mentioned, Lucile, which contains a celebrated quartet (1769); Le Tableau Parlant (1769); Les deux Avares (1770); Zemir et Azor (1771); Fausse Magie (1775); Richard Cœur de Lyon (1784). His dramatic works number fifty-one. He also wrote a mass for four voices, and other ecclesiastical pieces. He has been called the Molière of music, and is said to possess, along with natural grace and expression, the comic accent of musical language. He died in 1813 at Ermenonville, in Rousseau's hermitage. An edition of his works in 22 volumes appeared in 1883–97.

GREVILLE, Sir Fulke, Lord Brooke, an accomplished courtier and ingenious writer, and a great encourager of learning and learned men, was born in 1554 at Beauchamp Court, Warwickshire, the seat of his father, Sir Fulke Greville, a great landed proprietor. He attended Shrewsbury School, where he became a lifelong friend of Sir Philip Sidney, and afterwards proceeded to Jesus College, Cambridge. Having presented himself at court, he soon rose high in the favour of Elizabeth, and latterly was appointed secretary for Wales and treasurer of the navy. At the accession of James I. he was knighted, but his advancement is said to have been hindered by the jealousy of Cecil. After his death he rose rapidly, filling in succession the posts of under treasurer and chancellor of the exchequer, and in 1621 he obtained a barony. The king also added greatly to the estates which Greville had inherited. In 1628 he made a will disposing of his property, but omitted to provide for an old servant who acted as a witness of the document. Thinking himself unjustly treated, the servant reproached his master, who was then lying ill in London, and on receiving a reprimand, stabbed him with a sword. The assassin instantly committed suicide with the same weapon, but his master lingered for some weeks, and died on 30th September. Lord Brooke was the founder of an historical lecture at Cambridge, and enjoyed the friendship of Spenser, Bacon, and others of the master spirits of the age. His works (see Dr. Grosart's edition of 1870, 4 vols.) include: The Life of Sir Philip Sidney; Cælica, a collection of 109 songs; a Treatise of Humane Learning; an Inquisition upon Fame and Honour; Alaham and Mustapha, two tragedies; &c. He selected subjects for poetry of the most intractable kind, and even his tragedies were more like political treatises; his works exhibit much learning and reflection, together with considerable deficiency in power of expression, and a want of mastery of the medium through which he chose to convey his thoughts.

GREY, Charles, Earl, a distinguished statesman, was the eldest son of Charles, first Earl Grey, ennobled for his military services, and was born at Falloden, near Alnwick, on 13th March, 1764. He was educated at Eton, and afterwards at King's College, Cambridge, and on leaving the university made a tour on the Continent, visiting France, Spain, and Italy. Shortly after his return in 1786 he was returned to Parliament as member for Northumberland, and from the first, notwithstanding the Tory principles of his family, ranged himself in the ranks of the opposition. His first speech, which attracted great admiration, was on Pitt's commercial treaty with France, which Mr. Grey followed Fox in oppos-

ing. On the impeachment of Warren Hastings he was appointed, though not yet twenty-four, one of the managers for conducting his trial. During the period of the French revolution, when everything like an attempt to introduce any innovation in political matters was regarded as synonymous with Jacobinism and anarchy, he came fearlessly forward as an advocate of parliamentary reform, and was a persisting opponent of the war with France. On the accession of the Grenville ministry in 1806, Mr. Grey, who had now become Lord Howick, was made first lord of the admiralty, and on the death of Fox succeeded him as secretary for foreign affairs and leader of the House of Commons. He quitted office with his colleagues in March of the following year, and on the subsequent dissolution of Parliament and re-election took his seat again in the house as member for Appleby. The death of his father, in the ensuing November, raised him to the House of Peers, with the title of Earl Grey, and from this period up to 1830 he refrained from taking any official share in public matters, but headed the opposition in the Lords, distinguishing himself especially in opposing the proceedings against Queen Caroline. On the accession of William IV. and the retirement of the Wellington ministry, Earl Grey was summoned to office as the premier of the first liberal cabinet since the days of the Grenville ministry. The great event which marks his administration is the passing in 1832 of the reform bill. (See BRITAIN.) In consequence of an amendment carried on this bill in the House of Lords on 7th May the ministry resigned on the 9th, and only resumed office on the 18th, on receiving full powers to take whatever measures they deemed necessary to secure the passing of the bill without mutilation. The measure they had contemplated was the creation of new peers in sufficient numbers to overpower the opposition in the House of Lords, but the threat proved sufficient. The opponents of the bill absented themselves on the third reading, so as to leave the ministers a majority. The course taken by the ministry on this occasion may have been justified by the necessity of the case. Like Peel in abolishing the corn-laws, Earl Grey had, in taking it, to sacrifice his former convictions, and submit to the taunt of inconsistency. In 1827 he had declared, in opposing Mr. Canning's corn bill, that in the event of a contest between the lords and the people he would stand or fall by his order, adding, 'I will maintain to the last hour of my existence the privileges and independence of this house.' Such changes of opinion are perhaps rather a caution to orators than to statesmen. In 1834 Earl Grey resigned, and was succeeded by Lord Melbourne. The remainder of his life was spent in retirement, with an occasional appearance on some favourite subject in the House of Lords. He died at his seat in Northumberland on 17th July, 1845. Earl Grey married, in 1794, the daughter of Lord Ponsonby, by whom he had ten sons and five daughters.

GREY, LADY JANE, a young and accomplished female of royal descent, whose disastrous fate, as the victim of an unprincipled relative's ambitious projects, has created an extraordinary interest in her favour. She was the daughter of Henry Grey, marquis of Dorset, afterwards duke of Suffolk, by the Lady Frances, daughter of Charles Brandon, duke of Suffolk, and Mary, younger sister of Henry VIII., in whose reign Lady Jane was born, according to the common account, in 1537. She displayed much precocity of talent; and to the usual accomplishments of females she added an acquaintance with the learned languages, as well as French and Italian. Roger Ascham has related, that, on making a visit to Bradgate Hall, he found Lady Jane, then a girl of fourteen, engaged in perusing Plato's Dialogue on the Immortality of the Soul in the original Greek, while the rest of the family were hunting in the park. She owed her early proficiency in literature, in some measure, to her learned tutor, Aylmer, afterwards bishop of London; and from him she imbibed an attachment to Protestantism. The oriental as well as the classical languages are said to have been familiar to her, and she is represented as having been altogether a young person of uncommon genius and acquirements. But the latter are less singular than might be supposed by those who do not take into account the general taste for the cultivation of Greek and Roman lore, which prevailed among both sexes for some time after the revival of literature in Europe. Lady Jane Grey was a woman of talents, but not a prodigy; and Mrs. Roper, the interesting daughter of Sir Thomas More, with Lady Burleigh and her learned sisters, may be adduced as not inferior to her in learned accomplishments. The literary accomplishments of this unfortunate lady, however, do less honour to her memory than the spirit with which she bore the annihilation of her prospects of sovereignty, and the disgrace and ruin of the dearest object of her affections. The tale of her elevation and catastrophe has been often related, and has furnished a subject for dramatic composition. The most material circumstances are her marriage with Lord Guildford Dudley, fourth son of the Duke of Northumberland, in May, 1553; which, though it originated in the ambitious projects of her father-in-law, was a union of affection. Edward VI. was induced on his death-bed to settle on her the succession to the crown. He died on 5th July, 1553. The council endeavoured to keep his death secret, with a view to secure the persons of the princesses, Mary and Elizabeth. Mary was apprised of their design, and wrote them expressing her surprise that she had not been advised of her brother's death, and commanding them on their allegiance to proclaim her title. The council replied, exhorting her to be quiet and obedient, and proclaimed Lady Jane on the 10th. On the approach of Mary the council, who were unsupported in their usurpation, meanly deserted their victim Lady Jane, and joined in proclaiming her queen on the 19th, and on the 20th Lady Jane was confined to the Tower. On 13th Nov. she and her husband were arraigned, and pleaded guilty of high treason; but their doom was suspended, and they might, perhaps, have been allowed to expiate their imprudence by a temporary confinement, but for the ill-advised insurrection under Sir Thomas Wyatt, in which the Duke of Suffolk, Lady Jane's father, was weak enough to participate. The suppression of this rebellion was followed by the execution of Lady Jane Grey and her husband. Lady Jane resolutely defended her opinions against the arguments of the Roman divines sent to reason with her, and prepared herself with firmness for her approaching fate. She was beheaded on Tower Hill, February 12, 1554, her husband having previously suffered the same day. A book, entitled The Precious Remains of Lady Jane Grey (4to), was published directly after her execution; and letters, &c., ascribed to her may be found in Foxe's Martyrology.

GREYHOUND (*Canis Graius*, Linnæus). This variety of the canine race is distinguished by a greater length of muzzle than any other dog, a very low forehead, occasioned by the want of frontal sinuses, short lips, thin and long legs, small muscles, contracted belly, and semipendent ears. There are several subvarieties described by naturalists, as the Irish greyhound, the Scottish, the Russian, the Italian, and the Turkish, all which, though differing in size and intelligence, possess the general characteristics of the variety. The British greyhound is believed to be

descended from the rough hound which lived in Scotland at a very early period. The common greyhound is of a beautiful and delicate make of body, and is universally known as the fleetest of this race of animals. The name of this dog has no reference to the colour of the animal, but is evidently the same word as the Icelandic *greyhundr*, a greyhound, a word compounded of *grey*, a dog of some kind or other, and *hundr*, a hound. The greyhound has been for many centuries in the highest estimation, and in ancient times was considered as a most valuable present. The ardour and velocity of the greyhound in pursuit of its game have always been a matter of admiration to sportsmen, and of various opinions as to the difference of speed between a well-bred greyhound and a race-horse. It has, by the best judges, been thought that upon a flat the horse would be superior to the dog; but that in a hilly country the latter would have the advantage. The natural simplicity and peaceable demeanour of the greyhound has sometimes induced a doubt whether the instinctive sagacity of this particular variety is equal to that of some others of the species; but from numerous observations it appears that it possesses this attribute in a high degree. Greyhound pups, during the first seven or eight months, are extremely uncouth, awkward, and disproportioned, after which they begin to improve in form and sagacity. They reach their full growth at two years. The distinguishing traits of superiority are supposed to consist in a fine, soft, flexible skin, with thin, silky hair, a great length of nose, contracting gradually from the eye to the nostril, a full, clear, and penetrating eye, small ears, erect head, long neck, broad breast, width across the shoulders, roundness in the ribs, back neither too long nor too short, a contracted belly and flank, a great depth from the hips to the hocks of the hind legs, a strong stern, round foot, with open uniform clefts, fore-legs straight, and shorter than the hinder. According to the quaint description given in a work printed in 1496, by Wynkyn de Worde (the Book of St. Alban's), a greyhound should be

> 'Headed lyke a snake,
> Neckyed lyke a drake,
> Fottyed lyke a catte,
> Taylled lyke a ratte,
> Syded lyke a breme,
> And chyned lyke a beme.'

Greyhounds bred in countries where the ground is chiefly arable were formerly supposed superior in speed and bottom to those produced in hilly situations; that opinion, however, is completely superseded, and the contrary proved to be the case. If fed with coarse food, greyhounds are peculiarly liable to cutaneous and other affections.

GREYWACKE, or GRAU WACKE, is a name originally applied by Werner to a rock consisting of mechanically altered portions or fragments of quartz, indurated clay slate, and flinty slate, cemented by a basis of clay slate,—the imbedded particles not exceeding a few inches in diameter, and sometimes becoming so minute as to be no longer visible, when the rock was denominated *grau wacke slate*. The term greywacke, however, was restricted to the rocks now known as Cambrian and Silurian, and to which the name of Transition was applied by the early geologists, who considered that the rocks of these formations denoted the transition of the crust of the earth from an uninhabited to a habitable condition. The term greywacke is now seldom used, and is only employed to designate the hard gritty or brecciated rocks occurring in strata previous to the Devonian.

GRIESBACH, JOHANN JACOB, a German biblical critic, was born at Butzbach in Hesse-Darmstadt in 1745. He received his first instruction at the Gymnasium of Frankfort, and removed to the University of Tübingen in 1762. In 1764 he went to Halle, and afterwards spent a year at Leipzig. Ecclesiastical history was the subject of his studies, in which Ernesti, at Leipzig, aided him with books and advice. He next undertook, at Halle, an extensive course of preliminary studies to the criticism of the New Testament and dogmatic history. Having resolved to devote himself altogether to the criticism of the text of the New Testament, he undertook, in 1769 and 1770, a literary journey through Germany, England, Holland, and France. The following winter he devoted, in his native city, to the elaboration of his materials; and in 1771 appeared as a lecturer in Halle with such applause, in consequence of his celebrated treatise on the criticisms of Origen on the Gospels, that two years after he was appointed professor. He now pursued, with indefatigable industry, his plan of an edition of the New Testament. Having received an appointment to a regular professorship of theology at Jena, he published a synopsis of the Gospels (1774–75). This was followed about a year afterwards by the first edition of the whole Testament. Its peculiarity is, that it does not merely enumerate the accepted or rejected readings, but the different degrees of probability for or against them are determined and represented by intelligible marks in the margin. It is to be lamented that he could not finish, as he had intended, the complete edition, which was begun in 1796, and appeared simultaneously at Halle and London. He was, however, incessantly employed on it till his death (in 1812), and lived to see the superb edition, published by Goschen, finished. Gabler has edited Griesbach's Opuscula Academica (Jena, 1824, two vols.)

GRIFFIN, or GRYPHON (Greek, *grups*), a fabulous monster of antiquity, commonly represented with the body, the feet, and claws of a lion, the head and wings of an eagle, the ears of a horse, and instead of a mane, a comb of fishes' fins: the back was covered with feathers. Ælian says that its back was covered with black feathers, its breast with red, and its wings with white. Ctesias gives him blue and shining neck feathers, the beak of an eagle, and fiery eyes. Later writers add other particulars. According to one account, it is larger than an eagle, has on its fore-feet large claws, like those of an eagle, and others on its hind feet like those of a lion; and it lays an agate in its nest. Drinking-cups are made from its talons. The griffin is so strong, says Ctesias, that he conquers all beasts, the lion and elephant only excepted. India was assigned as the native country of the griffins, and it was believed that they built their nests on the mountains; that they could be easily caught and tamed when young, but never when full grown; that they found gold in the mountains, and built their nests of it; and that they guarded the gold in the mountains of India. Böttiger, in his Vasengemälde, has given much information concerning the origin of this fabulous animal. He maintains that this and similar monsters are merely the creation of Indian tapestry-makers, who, from the most ancient times, employed themselves on strange compositions of mythological beasts. The Greeks, who saw this kind of tapestry at the court of the King of Persia, thought that the animals depicted on it were really inhabitants of India, so rich in wonders, and they spread the report.

GRILLPARZER, FRANZ, a German poet and dramatist, born at Vienna, 15th January, 1791. On the conclusion of his studies in 1811 he became tutor in the family of an Austrian noble. In 1813 he entered the service of the imperial court, and rose from dignity to dignity till 1856, when he retired

into private life with the title of Hofrath (court councillor). In 1861 he was appointed member for life of the imperial council. He became first known to the public as a dramatist in 1816 by his Ahnfrau, a tragedy of the fatalistic school, which still keeps the stage. It was followed by the dramas Sappho (1819); Das Goldene Vliess (1822); Des Meeres und der Liebe Wellen (1840), an adoption of the legend of Hero and Leander. Perhaps the finest of Grillparzer's productions is the historical drama of König Ottokar's Glück und Ende (1825), which possesses much dramatic interest. He also published several lighter pieces, such as Wehe dem, der lügt (1840), Der Traum, ein Leben (1840), &c.; a novel, Der Spielmann; a poem, Radetzky (1848); and a collection of lyrical and epigrammatic poems, all of which stand well in popular favour. His ordinary uneventful official and literary life was varied by travels in Italy (1819), Germany (1826 and 1847), and to Constantinople and Greece (1843). He died at Vienna, 21st January, 1872.

GRIMALDI FAMILY, one of the four old families of the high nobility in Genoa (the others being Fieschi, Doria, and Spinola). The lordship of Monaco (afterwards elevated to a principality) belonged to the Grimaldi from 980 onwards. With the Fieschi they always played an important part in the history of Genoa, especially in the disputes between the Ghibellines and the Guelfs, to which latter party both families belonged. The main line of the Grimaldi, princes of Monaco, came to an end with Antonio Grimaldi in 1731, after which the name and territory passed to his son-in-law, Jacques François Léonard de Goyon-Matignon, and still remains with this line. The present prince has made his name known in the scientific world, especially by his deep-sea dredgings.—GIOVANNI FRANCESCO GRIMALDI, known as *il Bolognese*, being born in Bologna in 1606, was a landscape-painter of some eminence, also an architect and engraver. He died in 1680.

GRIMALDI'S FRINGES, a technical term in optics given to the coloured bands observed when a beam of light passing through a narrow slit falls on a screen. They are due to interference of the waves which constitute light (see INTERFERENCE), and are named from Francesco Maria Grimaldi, who wrote a treatise on the subject.

GRIMM, FRIEDRICH MELCHIOR, BARON, counsellor of state of the Russian Empire, grand cross of the order of Vladimir, a man of letters, whose great reputation has arisen from posthumous publications. He was born in 1723 at Ratisbon, of poor parents, who, however, bestowed on him a good education. Having finished his studies, and produced a tragedy, Banise, of no particular merit, he went to Paris as governor to the children of the Count of Schönberg. Soon after he was appointed reader to the Duke of Saxe-Gotha. At this period he became acquainted with Jean Jacques Rousseau, who introduced him to Diderot, D'Alembert, D'Holbach, and other Parisian philosophers—a piece of service which, according to Rousseau (Confessions, 8), he repaid with ingratitude. The Count de Friese made him his secretary, with appointments which rendered his circumstances agreeable, and left him at liberty to pursue his inclinations. The arrival of a company of Italian singers in Paris having divided all the musical connoisseurs into two parties, Grimm declared for the Italian music, and was at the head of the *coin de la reine*—a party so called because they used to sit in the pit, under the queen's box—whilst the friends of Rameau and the French music formed the *coin du roi*. Grimm wrote on this occasion a pamphlet, full of wit and taste, Le petit Prophète de Bömischbroda, and when his adversaries attempted to answer it completely confuted them by his Lettre sur la Musique Française. These pamphlets irritated so many persons against him that they talked of exile, the Bastille, &c.; but when the excitement had subsided they obtained general applause. On the death of the Count de Friese Grimm was nominated principal secretary to the Duke of Orleans. The fame of the French literati with whom he was connected led to his being employed, in conjunction with Diderot, to transmit to the Duke of Saxe-Gotha an account of the writings, friendships, disputes, &c., of the authors of that period. Copies of this curious correspondence were also sent to the Empress Catharine II., the Queen of Sweden, Stanislaus, king of Poland, the Duke of Deux-Ponts, the Prince and Princess of Hesse-Darmstadt, &c. Frederick the Great gave him marks of great esteem. In 1776 he was appointed envoy from the Duke of Saxe-Gotha to the French court, honoured with the title of baron, and with several orders. On the revolution breaking out he retired to the court of Gotha, where he found a safe asylum. In 1795 the Empress of Russia made him her minister plenipotentiary to the states of Lower Saxony; and he was confirmed in that post by Paul I., and retained it till ill health obliged him to relinquish it. He then returned to Gotha, and died there December 19, 1807. His grand work was published in different portions successively under the following titles:—Correspondance littéraire, philosophique et critique, adressée à un Souverain d'Allemagne, depuis 1770 jusqu'en 1782, par le Baron de Grimm et par Diderot (Paris, 1812, five vols. 8vo); Correspondance littéraire, &c., en 1775, 1776, 1782–90 (troisième et dernière Partie, 1813, five vols. 8vo); and Correspondance littéraire, &c., depuis 1753 jusqu'en 1760 (première Partie, six vols. 8vo). The latest edition of this work, valuable for the information it contains on literary and social affairs during an interesting period of French history, was published at Paris in 1878–82 in sixteen volumes.

GRIMM, JAKOB LUDWIG, a German philologist and literary historian, was born at Hanau in Hesse-Cassel, 4th January, 1785. He was educated first under Zinkhan at Steinau an der Strasse, and then at the Lyceum of Cassel. In the spring of 1802 he went to the University of Marburg to study law under Savigny, the celebrated writer on Roman jurisprudence, who, having gone to Paris in 1804, invited his pupil in the following year to join him and assist him in his literary labours. On his return to Hesse, after a stay of some months, he was appointed secretary of war, and devoted his scant leisure time to the study of mediæval literature, especially that of his own country. On the creation of the Kingdom of Westphalia in 1806 he was appointed librarian to King Jerome Bonaparte, and in 1809 auditor in the council of state. After Jerome Bonaparte had been compelled, in October, 1813, to retire from Germany, and the Electorate of Hesse-Cassel restored to its former state, Jakob Grimm was appointed in December of the same year secretary of legation to accompany the Hessian minister to the head-quarters of the allied army, and at the Congress of Vienna in 1814 and 1815. He was afterwards sent by the Prussian government to Paris to obtain the restitution of valuable manuscripts which had been carried off by the armies of Napoleon. Resolved to retire from public life he accepted in 1816 the post of second librarian at Cassel, which he held for a period of thirteen years. On the death of Völkel, the first librarian, Grimm expected that he would receive the appointment, but was disappointed, and accepted in 1830 an invitation to Göttingen both as professor and librarian. Here for seven years he delivered remarkable lectures on the history of the German

language, literature, and law. Having been one of the seven professors who in 1837 signed a protest against the measures taken by the new King of Hanover to abrogate the constitution which had been established some years previously, Grimm was deprived of his office and banished from the country. He lived in retirement in Cassel till 1841, when he was called to Berlin as member of the Academy of Sciences and as professor. He presided over the assemblies of German philologists held in Frankfurt in 1846 and in Lübeck in 1847, and sat in the national assembly of 1848 and in the assembly of Gotha in 1849, voting with the moderate liberal party. From that time till his death, which took place at Berlin 20th September, 1863, he occupied himself only with his various publications. The labours of Grimm are of unrivalled importance in the broad field of German literary antiquities. The constant aim of his investigations has been to trace the spiritual life of the German people as revealed in their laws, customs, faiths, and poetry. His first publication was Ueber den altdeutschen Meistergesang (Göttingen, 1811). It was followed by his Deutsche Grammatik (vols. i.–iv. 1819–37), which is perhaps the greatest philological work of the age, and which may be said to have laid the foundation of the historical investigation of language. This work, as well as the great Deutsches Wörterbuch, commenced in 1852, in conjunction with his brother Wilhelm, he did not live to complete. The completion of this latter work was undertaken by Hildebrand and Weigand, and through their labours and those of other scholars the end is slowly being approached. His Deutsche Rechtsalterthümer (1828), Mythologie (1835), Geschichte der deutschen Sprache (two vols. Leipzig, 1848), and Ueber den Ursprung der deutschen Sprache are important and exhaustive works. He also published, in company with his brother, the Kinder- und Hausmärchen (Berlin, 1812), one of the most popular collections of juvenile fairy tales, which has seen many editions; Deutsche Sagen (two vols. 1816–18); Irische Elfenmärchen (1826), founded on Crofton Croker's Fairy Legends; Altdeutsche Wälder (three vols. 1813–16); &c.

GRIMM, Wilhelm Karl, brother of the preceding, was born at Hanau 24th February, 1786. He was educated at Cassel and Marburg, and in 1814 was appointed secretary of the library of Cassel. In 1830 he followed his brother to Göttingen as second librarian, and subsequently obtained a professorship. He joined his brother in the protest against the abrogation of the new Hanoverian constitution, and like him was deprived of his office. The two brothers succeeded in obtaining appointments in Cassel, and subsequently in Berlin. He died in that city 16th December, 1859. He devoted himself especially to the German mediæval poetry, and besides the works produced in connection with his brother, he has published a treatise, Ueber die deutschen Runen (1821); a translation of Altdänische Heldenlieder, Balladen und Märchen (1811); and has edited the Grave Ruodolf (1828); Die deutsche Heldensage (1829); Der Freidank (1834); Der grosse Rosengarten (1834); Das Rolandslied (1838); &c., all with valuable introductions and disquisitions.

GRIMMA, a town of Germany, kingdom of Saxony, charmingly situated in a deep valley on the left bank of the Mulde, 17 miles E.S.E. of Leipzig. It has spacious streets, and well-built houses; a church of the 13th century, a town-house of the 15th, an old royal castle, now accommodating public offices, handsome school buildings, endowed school, real school, normal schools, &c. The industries include flour-milling, machine making, iron-founding, &c. Pop. (1895), 9804; (1900), 10,892.

GRIMM'S LAW. See Philology.

GRIMSBY, formerly Great Grimsby, a parl., mun., and county borough and seaport of England, in Lincolnshire, 30 miles north-east of Lincoln, on the right bank of the Humber. Though a place of some antiquity, much the greater part of it has been built since the middle of the nineteenth century, when new docks were constructed in connection with the Manchester, Sheffield, and Lincolnshire Railway. Some of the places of worship are handsome buildings (as the church of St. James), and so are the buildings occupied by the town-hall and grammar-school; and the custom-house, hospital, corn exchange, mechanics' institution, dock offices, may also be mentioned. The town possesses an attractive public park and pleasure-grounds. The docks occupy an area of about 140 acres, and additions continue to be made from time to time. There is regular steam communication with the Baltic, and a considerable trade is also done with the western Continental ports. Grimsby is the most important fishing port of the kingdom. Many hundreds of fishing smacks and numerous trawlers belong to it, and vast quantities of cod, herrings, and other fish are landed here and despatched to inland towns. Ship-building (to a small extent), tanning, rope-making, &c., are carried on. It sends a member to the House of Commons. Pop. (1891), mun. bor. 51,876; parl. bor. 58,603; (1901), 63,138 and 78,198.

GRINDELWALD, an Alpine valley of Switzerland, canton of Berne, having on its south side the Eiger (12,260 feet), Mettenberg (9800), Schreckhorn (12,568), Mönch (12,609), &c.; and between these mountains, and on either side of the Mettenberg, two famous glaciers. The village of Grindelwald consists of picturesque scattered cottages. Pop. 3500.

GRINDING, a mechanical process in which certain effects are produced by the attrition of two surfaces. This process is of extensive use in various mechanical arts, as in grinding corn, ores, colours, in which cases the object is to reduce the materials by crushing to a fine powder; or in grinding the metals, glass, and other hard substances for the purpose of giving them a certain figure or polish or a sharp cutting edge. In the first case the grinding or crushing is effected by passing the material between rough stones, as in the common flour-mill, or as in crushing ores between heavy metal cylinders, smooth or fluted, according to the degree of fineness required, or by a heavy stone or iron cylinder revolving upon a smooth plate. Chicory, chocolate, plumbago for pencils, and a variety of other substances are ground by iron or stone rollers, revolving on a slab in such a manner that they not only merely roll but also rub on the surface of the slab. A knife or scraper follows one roller and precedes the other, scooping the paste into the position required to come fairly under the roller which follows it. Colours are ground in small quantities with a muller and slab. The muller is a heavy piece of stone of conical shape, and which rests its base on the slab and is grasped by the hands; the colour is mixed to a pasty consistence with the desired medium of oil or water, and rubbed between the two surfaces until smooth and impalpable. The grinding of cutlery and tools is effected by means of the grindstone (see below); glass lenses and metal specula are ground to shape with emery-powder laid on a metal tool. Ornamental glass is ground into facets or otherwise by means of stones and lap-wheels. Diamonds and other precious stones are cut or ground with diamond dust embedded in soft iron. Large flat surfaces are obtained by first working two pieces of the material nearly flat and then laying the one upon the other and grinding their surfaces together with sand, emery, or other cutting powder. Plate-

glass is flattened in this way; also surfaces of cast-iron, where accurate fitting is required. Sockets and other bearings which require to be fitted with great nicety are usually finished by being ground together. For brass or bell-metal pumice-stone is employed in such cases, as emery is apt to embed itself in the metal and give it a permanent abrading action on the bearings. Dry grinding is the term applied to the grinding of steel with dry grindstones. The points of needles and forks are produced by this means, also the finishing of steel pens and the surface of gun barrels. The men and women engaged on this kind of work suffer painfully from irritation of the throat and nostrils caused by the nature of it, and although the distressing effects have in recent years been considerably diminished by the introduction of currents of air to carry off the minute particles of the steel, and mouth-pieces of damp cloth, the evil is far from being obviated, especially among the gun-barrel grinders. These workmen are subject to another great danger; the stones, which are very large, and revolve with great rapidity, occasionally break, and large pieces fly off in all directions, endangering the lives of the men. Sand-jet grinding is a remarkable process, in which abrasion is effected by the percussion of small hard particles on a plain surface. Sharp siliceous sand, varying in hardness and fineness according to the kind of work to be done, is employed in most cases. This sand is impelled by a blast artificially produced of steam or of air. A hole 1½ inch in diameter by 1½ deep, has been bored through a solid piece of corundum (the hardest mineral known except the diamond) in twenty-five minutes by sand driven with steam-power at 300 lbs. pressure on the square inch. A diamond has been sensibly reduced in weight, and a topaz altogether dissipated by a sand-jet in one minute. These results are obtained by causing a sand-stream to mix with a steam jet. The sand passes through a central air-tube, and the steam through an annular tube which surrounds it; a kind of suction acts at the end of the concentric tubes, which draws the sand into the steam jet, and both dash with great force against the stone or other substance to be acted upon, which is placed at about an inch from the mouth of the tube. By the use of flexible jointed connecting tubes the jet can be turned in any direction, and grooves, mouldings, letters, &c., can be produced instead of merely straight cuts or cavities By using an air jet instead of steam, and varying the pressure, a design can be engraved on glass, the parts not to be acted upon being covered with the pattern, made of paper, lace, india-rubber, or oil-paint.

GRINDSTONE, a cylindrical stone, on which cutting tools are sharpened, glass, stone, and other substances cut or abraded by being brought into contact with the convex surface while the stone is revolving on its axis. They are made of sandstone, or sandstone grit of various degrees of fineness, according to the nature of the work to be performed. A very fine stone is found at Bilston in Staffordshire; it is of a sharp nature, and yet not too hard. Good stones may also be obtained from the coal districts of Northumberland, Durham, Yorkshire, and Derbyshire; they are usually called Newcastle grindstones. The Sheffield grindstone, used for grinding large files and the like, is a coarse grit stone obtained from Hardsley, about 14 miles north of Sheffield. An artificial stone, the invention of Mr. Ransome, has been tried as a material for grindstones or millstones. The substance consists of sand, gravel, pebbles, fragments of limestone or granite, ground up very fine, sifted, and mixed into a paste with a liquid prepared by dissolving flint in a solution of caustic soda under pressure and at a high temperature. The paste, when mixed is poured into moulds of the required shape, dried slowly, and steeped in a solution of chloride of calcium. By proportioning the ingredients various degrees of fineness may be obtained. Sharp, clean, dry sand is best suited for grindstones. By skilful workmanship stones can be made quite free from flaws, of any size and of any degree of hardness.

GRIQUALAND WEST, a district of the Cape Colony, bounded on the south and south-west by the Orange River; north, north-east, and north-west by Southern Bechuanaland; and east by the Orange River Colony; area, 15,197 sq. miles. The general elevation of the land is about 3000 feet above sea-level, and the prevailing character of the surface is that of undulating grassy plains suitable for sheep grazing, alternating with sandy plains and low ranges of rocky hills. In 1870 large finds of diamonds in the district began to attract wide notice, and soon drew hosts of diggers. Becoming thus an object of great interest several claims to the territory were put forward, among others by the Orange Free State, and by Waterboer, the Griqua chief. In 1871 the latter ceded all his rights to the British government, and the territory was proclaimed a part of the British Empire, being incorporated with Cape Colony. The Free State continued to maintain its claim to part of the region, but relinquished it in 1876 for a sum of about £90,000. At present the diamond-bearing districts constitute almost the sole dependence of the population. The chief centre of the mining industry, and the seat of government of the country, is Kimberley (pop. about 30,000). The annual value of the mines is about £4,000,000. The coloured population consists partly of Griquas, and partly of Bechuanas and other tribes. Pop. in 1904, 108,362 (Europeans 32,720). *Griqualand East*, one of the four divisions of Kaffraria, or the Transkeian Territories of Cape Colony, is situated south of Natal, between Pondoland and Basutoland. Its western frontier is the crest of the Drakenberg. Basutos and Kaffirs now outnumber the Griquas in its population, and stock-rearing is the principal occupation of the inhabitants. The chief town, Kokstad, is on the projected railway through Kaffraria to Natal. Area, 7549 sq. miles; pop. in 1904, 353,830, of whom 6657 are white.

GRISELDA, the ever-patient wife of the Marquis di Saluzzo, the subject of the tenth *novella* in the tenth *giornata* of Boccaccio's Decameron. The marquis's *beau ideal* of a wife was a woman of all-enduring patience. He chooses Griselda, the daughter of one of his tenants, ill-treats her in a variety of ways, takes away her two sons, and makes her believe that they are killed. At last he turns her out of doors in her shift, and celebrates a marriage with a noble lady. But finding that Griselda endures everything patiently he takes her back, restores her two sons, and treats her as marchioness. This subject has been treated by writers of many other nations; and in England it furnished Chaucer with material for one of his tales.

GRISI, GIULIA, a celebrated Italian vocalist, was born at Milan 28th July, 1811, or according to others in 1812. She studied music in the conservatory of her native town and at Bologna. She made her debut in the theatre of that town in Rossini's Zelmira, when she had reached her sixteenth year, and made a great impression. At Milan she first appeared as Norma, a *rôle* which she made completely her own. In 1832 she sang at the Théatre Italien, Paris, where she soon came to be considered a worthy rival of Pasta and Malibran. The French capital became, for a lengthened period, her place of residence from that date, as she quitted it only for the short summer opera season in London. In 1836 she

became the wife of Mons. Gérard de Melcy, an unhappy union which was soon afterwards judicially dissolved. Her visits to England now became more frequent and protracted, and she was looked upon by the British public for a long series of years as the queen of the lyric stage. In 1854 she made a successful tour in America accompanied by the great tenor Mario, to whom she was subsequently married. On her return to Paris in 1856 it was painfully evident that her exquisite voice had begun to give way. She struggled bravely against the cold reception she met with from the Parisians, but could only create a faint enthusiasm by appearing in her great character of the Druid priestess. In 1860 she went to Madrid, where she was equally unsuccessful. Four years later she appeared on the Covent Garden stage, and received a warm welcome from her ancient admirers. She subsequently visited the provinces, and at various intervals made short excursions to the Continent. She died at Berlin in November, 1869.

GRIS-NEZ, Cape (ancient, *Itium promontorium*), a headland, France, dep. Pas-de-Calais, equally distant from Calais and Boulogne and the nearest point of the French shore to that of Britain (South Foreland), the distance being barely 21 miles. It has a revolving light, 195 feet high; lat. 50° 52′ 12″ N.; lon. 1° 35′ 15″ E.

GRISONS (German, *Graubünden* or *Bünden*), the largest canton of Switzerland; bounded N. by the cantons of Glarus, St. Gall, the principality of Liechtenstein, and the Tyrol, E. the Tyrol; S.E. Lombardy; S. Lombardy and the canton of Tessin; and W. the canton of Uri; greatest length, east to west, 90 miles; greatest breadth, 52 miles; area, 2773 English square miles. Its limits are determined almost throughout by lofty mountain ranges, and a great part of the interior, particularly toward the east, is covered by their ramifications, and includes more than twenty peaks above 9000 feet. The valleys which lie between the ranges are generally narrow, though in a few instances they attain a considerable breadth, as those of the Upper and Lower Engadine. Only a small portion of the east and south-east of the canton belongs to the south side of the great watershed of Europe, and is drained chiefly by the Inn, and by small affluents of the Adige and Adda. The rest of the Grisons west of this range, amounting to at least two-thirds of the whole, belongs to the basin of the Rhine, whose two head streams, the Vorder and the Hinter Rhine, which here originate, with their affluents the Glenner, Albula, Plessur, Lanquhart, &c., are the principal water-courses of the canton. The lakes also are numerous, and many of them present scenery of the most magnificent description, but individually they are of limited extent. The most deserving of notice are those of the Sils, Silvaplana, St. Moritz, and Poschiavo. The climate is much more diversified than is usual even in the Alpine districts of Switzerland. Often, after travelling for days over bleak and elevated tracts, where perpetual winter seems to reign, the traveller suddenly arrives at some deep valley, where the air is not only mild, but may almost be said to be Italian. In the loftier districts, situated at the height of nearly 6000 feet, the snow lasts to the end of May, and in some years continues late into July, while in the lower valleys, situated on the southern slopes, the labours of the plough commence in the middle of February or beginning of March. In general, however, the plough has a very limited range, and the whole is eminently pastoral, feeding large numbers of cattle and sheep, and producing much excellent dairy produce. In some lower districts not only cereals, but maize are grown. Hemp and flax, too, are cultivated to some extent; and though figs and almonds attain maturity only on part of the Italian side of the mountains, cherries, apples, and chestnuts abound in many quarters. On the mountains, particularly in the north, are dense forests, chiefly of pine and birch. At lower altitudes the oak, beech, and elm are common. The mountains on the north side of the canton are chiefly composed of argillaceous schist and limestone; those in the south and near the centre, chiefly of primitive rocks. Minerals of value, particularly iron, occur in extensive seams, but are not worked. Considerable quantities of gold have been gathered at different times. White marble of excellent quality, fit for statuary, might be worked to any extent. There are no manufactures of any consequence, but a considerable transit trade is carried on between Italy and Germany. The principal exports are cattle and wood. The constitution is very democratical, the legislative power being lodged in a council elected by a universal suffrage, which includes all citizens who have attained the age of twenty years (there being one member for every 1300 inhabitants), while there is an executive council of five members similarly elected, the latter for three years, the former for two. The canton is the fifteenth in the confederation (cap. Coire or Chur), being admitted so late as 1803, and was long divided into three principal parts or *Bünden*. Both the Calvinistic and the Roman Catholic religion are established. The language of the public acts is German, and of the people about three-eighths speak German, one-half Romansh, and one-eighth Italian. Pop. (1900), 104,510.

GROAT (Dutch, *Groot*), a silver coin, ordered to be coined by Henry III. in 1249, and coined by Edward III. about 1351. It was equal to fourpence of our present money. A coin of this value, but not bearing the name, was revived in the modern fourpenny piece issued from the mint in 1835. None of these pieces have been struck since 1856.

GROATS, the seeds of oats prepared as an article of food by being deprived of their hulls. They are much used in the preparation of gruel for invalids, and were formerly used in soups and broths like pot-barley.

GRODNO, a town, Russia, capital of the government of same name, partly on a height, and partly in a valley, on the right bank of the Niemen, 160 miles north-east of Warsaw. It is poorly built, consisting of an intermixture of stone and wooden houses huddled together in ill-formed and very dirty streets. The market-place, however, is spacious, and two or three of the streets are of a better description. The principal buildings are three palaces, one of them erected by Augustus III. of Poland, twelve churches, nine of them Roman Catholic, two Greek, one Lutheran, a gymnasium, and medical school, with a library, museum, and botanic garden. The manufactures consist of woollen, linen, and silk goods, hats, cards, firearms, &c., and the trade, favoured by the Niemen, is considerable. Pop. 46,871.—The government of Grodno, bounded on the N. by Wilna, on the E. by Minsk, on the S. by Volhynia, and on the W. by Poland and Bialystock, is 270 miles long from north to south, by 230 miles broad, and has an area of 14,931 English square miles. The surface is an entire level, only broken by a few chalk hills, and chiefly occupied by pine forests and swamps, but with some fertile tracts. Pop. (1897), 1,617,859.

GROG, a general name for any spirituous liquor and water mixed together; but it is more particularly applied to rum and water cold, without sugar. In the British navy, where a regular daily allowance is served out to the men, those who prefer abstaining from it are now allowed to receive money or tea instead of it.

GROIN, in architecture, the angular curve made by the intersection of two semi-cylinders or arches. It is either regular or irregular:—*regular*, when the intersecting arches, whether semicircular or semi-elliptical, are of the same diameters and heights; and *irregular*, when one of the arches is semicircular and the other semi-elliptical. The name groin or *groyne* is also applied to a small breakwater constructed on a beach between high and low tide-marks in order to retain sand or mud cast up by the water.

GROMWELL, the popular name of plants of the genus *Lithospermum*, belonging to the natural order Boraginaceæ. The species are mostly hairy herbs with funnel-shaped or rotate corollas of various colours. The limb is five-parted, and the throat, unlike that of the species of *Myosotis*, is not closed by scales. The stamens are included, and each flower is succeeded by four smooth stone-like nutlets. Three species are natives of Britain, and the fruits of one of them (*L. officinale*) are sometimes used in medicine.

GRONINGEN, a province of Holland, on the coast of the German Ocean, containing an area of 790 square miles. It is protected against the encroachments of the sea by dikes. It is very level, and is intersected by innumerable canals, partly for the purpose of safety, and partly to drain the land, which is in some parts fertile, in others sandy, and in others marshy. Much marshy land has been reclaimed and utilized by draining. There are many lakes. The climate is damp. The principal crops are cole and linseed, with the usual cereals, legumes, and potatoes. Horses, cattle, sheep, and pigs are extensively reared and exported, and dairy-farming and fishing are carried on. The inhabitants, in 1897, 296,521, nearly all belong to the Calvinistic Church.

GRONINGEN, capital of the above province, and the chief town of Northern Holland, is situated at the junction of the rivers Hunse and Aa, which here form the Reitdiep, now canalized and admitting of sea-going vessels reaching the town from the North Sea; there are also canals to the estuary of the Ems for large vessels, and to the Zuider Zee, and the town is an important railway centre. Groningen is regularly built, and has broad straight streets, adorned with many excellent buildings, public and private. It is nearly in the figure of a pear, and had once strong fortifications, the site of which has been planted. It presents a pleasing appearance, from the number of its gardens and open spaces. The chief of these is the market-place, called the *Groote Markt*, one of the largest in Holland. The buildings include St. Martin's Church, a fine Gothic structure, with an excellent organ and a tower 344 feet high; a large and elegant town-house; a fine exchange, and the university, founded in 1615, attended by about 450 students, and possessed of a library, a botanical garden, and a natural history museum. The other leading institutions are a deaf and dumb institute, a normal school, a gymnasium and other secondary schools, academy of fine arts, &c. The industrial establishments produce woollen goods, tobacco and cigars, gold and silver wares, furniture and mirrors, refined sugar, stoves, anchors and heavy iron goods, and there are oil, grain, and saw mills, and ship-building yards. There is an excellent harbour, with an active trade. The grain trade is very extensive; other articles of trade are oil-seeds and butter. Pop. (1897), 63,863.

GRONOVIUS (properly *Gronov*), the name of several Dutch classical scholars.

1. JOHANN FRIEDRICH, one of the most learned students of antiquities, was born at Hamburg in 1611. He studied at Leipzig and Jena, and went through a course of law at Altdorf, spent some time in Holland and England, was appointed professor of history and eloquence at Deventer (1643), and, after the death of Daniel Heinsius, succeeded him as professor of belles-lettres at Leyden (1658), where he died, 1671. With extensive knowledge he combined indefatigable industry and amiable manners. His editions of Livy, Statius, Justin, Tacitus, Gellius, Phædrus, Seneca, Sallust, Pliny, Plautus, &c., and his Observations, are valuable for their notes and improved readings. His Commentarius de Sestertiis displays a thorough acquaintance with the Roman language and antiquities; and his edition of Hugo Grotius' work, De Jure Belli et Pacis, is justly valued on account of the notes.

2. His son JAKOB, born at Deventer, in 1645, studied there and at Leyden. He spent some months at Oxford and Cambridge, and returned to Leyden, where he published, in 1676, an edition of Polybius, which met with such applause that he received an offer of a professorship at Deventer. He refused it, however, from a desire to travel through France, Spain, and Italy. The Grand-duke of Tuscany conferred on him a professorship at Pisa, which he relinquished in 1679, and was appointed professor of belles-lettres at Leyden and geographer to the university. He died at Leyden in 1716. This learned and industrious critic edited Tacitus, Polybius, Herodotus, Pomponius Mela, Cicero, Ammianus Marcellinus, &c., and compiled the valuable Thesaurus Antiquitatum Græcarum (Leyden, 1697–1702, thirteen vols. fol.). He also promoted the publication of the collections of Grævius.

GROS, ANTOINE-JEAN, BARON, one of the most celebrated French historical painters, was born at Paris on March 16, 1771. At the age of fourteen he became a pupil of David, and in 1794 left Paris with the intention of completing his studies at Rome. His means, however, were not sufficient for the journey, and he had to rely for his sustenance on what he could earn as a portrait-painter in the various towns he passed through. At Genoa, in 1796, he was drawn for the French army, and soon became a staff-officer. Josephine, afterwards empress of France, saw and admired several portraits by the young officer, and he was called upon to paint that of Bonaparte. The result was an excellent picture representing Napoleon leading his troops over the bridge of Arcola. In 1804 he produced his Peste de Jaffa, with Napoleon visiting the sick, a picture which is considered by many to be his master-piece. He painted, in rapid succession, the Bataille d'Aboukir (1806); Bataille d'Eylau (1808); La Prise de Madrid; Wagram; and La Bataille des Pyramides (1810). In France his chief work is considered by some to be the Cupola of St. Geneviève at Paris, exhibiting the saint protecting the throne of France, represented by Clovis, Charlemagne, St. Louis, and Louis XVIII. This picture covers an immense space, and is correct in design but defective in colour and expression. The artist received for it 100,000 francs and the title of baron. The rise of the romantic school bore away from him the tide of popularity, and there can be no doubt that his later works were inferior to his earlier. He made a last attempt to compete with the new school in his Hercule et Diomède, which was a failure. He then closed his studio, and soon after his body was drawn out of the Seine, near Meudon, 26th June, 1835.

GROSBEAK. Some confusion exists in the use of this name, which is used as a general popular name for birds belonging to at least three groups. The first of these comprises the cross-bills (Loxiinæ) of Europe and North America, which have the upper and lower mandibles passing each other, so that the

points cannot meet, as in the large-beaked cross-bill, *Loxia pityopsittacus* (Bechst.), and the common cross-bill, *L. curvirostra*, Gm. In the second group is the East Indian representative genus *Paradoxornis*, with the beak large and parrot-like, but not crossing. The group of the Pyrrhulinæ includes the Pine Grosbeak (*Pinicola enucleator*), the carmine grosbeaks—for example, the Rose Finch (*Erythrothorax roseus*), and the genus *Pyrrhula*, to which the common Bullfinch (*P. vulgaris*) belongs. The term grosbeak was given to birds which had beaks proportionally larger than in the most familiar forms, as the sparrow and swallow. Now the cross-bills are remarkable in this way (the distortion being merely accidental), so remarkable that they were placed close to the Parrots by those who were guided merely by general aspect. Thus the grosbeaks came to form a large and unnatural assemblage of birds whose beaks are more or less strong, capable of dealing with stone fruits, whose habits are shy and whose vocal powers are limited. In this wide sense the Cardinal Bird (*Cardinalis Virginianus*), the Green Finch (*Coccothraustes chloris*), the Rose-breasted Haw Finch (*Coccoborus Ludovicianus*), the Sugar Bird (*Hesperiphona vespertina*) of North America, the Blue Parrot Finch (*Pitylus cærulescens*) of South America, may be spoken of as grosbeaks though they belong to different genera and even families.

GROSCHEN, a name applied in Germany to certain coins, formerly in use. The first coins called groschen are said to have been coined at Kuttenberg, in Bohemia, about the year 1300. They were of silver, and were of the value of about 8*d*. sterling. The name spread over the whole of Germany and came to be applied to almost all small silver coins. Latterly the German groschen was a silver coin forming the chief subdivision of the thaler (3*s*. sterling), there being 30 groschen in the thaler. Since the introduction of the new German coinage (see GERMANY) reckoning by groschen has ceased.

GROSE, FRANCIS, an eminent antiquary, was born at Greenford in Middlesex in 1731. His father, Francis Grose, was a Swiss, who had settled in England as a jeweller. He obtained an appointment at an early age in the Herald's College, but quitted it in 1763 to become adjutant and paymaster of the Hampshire militia. He afterwards became a captain in the Surrey militia. On the death of his father in 1769 he was left with an independent fortune, which his improvident habits soon dissipated. This, however, had only the effect of stimulating him to exertion, and determining him to turn to account his genius for drawing and antiquarian science. In 1773 he commenced the publication in numbers of his Views of Antiquities in England and Wales, and finished them in 1776. Two more volumes were subsequently added to his English Views, including the islands of Jersey and Guernsey. In 1789 he made a tour in Scotland for the purpose of illustrating the antiquities of that country, and in 1790 the publication of a work on this subject commenced. Before completing it, however, he proceeded in the spring of the following year to Ireland, with the view of collecting its antiquities in a similar manner, and shortly after his arrival in Dublin was suddenly seized and carried off by a fit of apoplexy, in the house of a Mr. Hone, on 12th May, 1791. His name is now perhaps chiefly remembered in connection with the satirical verses of Burns, who wrote his Tam o'Shanter for him, and who has immortalized his antiquarian lore and corporeal obesity. In addition to the works already mentioned, Captain Grose is the author of a Treatise on Ancient Armour and Weapons, a Classical Dictionary of the Vulgar Tongue, Military Antiquities, the History of Dover Castle, and other publications.

GROSS (from the Italian), in opposition to *net*, is applied to merchandise, including that in which it is packed. It refers particularly to weight. Thus we say, 'The bag of coffee weighs 9 cwts. *gross*', that is, including the weight of the bag.

GROSS-BEEREN, a village of Prussia, near Berlin, noted as being the scene of an obstinate conflict on the 23d August, 1813. The armistice concluded between Napoleon and the allied powers having expired on the 17th of August in that year, the war commenced anew, and the Emperor of France resolved on the occupation of the Prussian capital. Berlin was protected by the militia and the northern army, commanded by Bernadotte, then crown-prince of Sweden, and consisting of the third and fourth Prussian divisions, the Russian corps under Woronzow, Winzingerode, and Czernitschef, and about 22,000 Swedes. The French army, reinforced by the forces of Würtemberg, Bavaria, Darmstadt, and Saxony, was formed into four divisions, led by Oudinot (the general-in-chief), Victor, Regnier, and Bertrand, and was, together with the cavalry, under Arrighi, from 80,000 to 90,000 strong. Napoleon had instructed Davoust, who was in Hamburg, and Girard, who was in Magdeburg, to co-operate with this army; but they were prevented by the tactics of Bernadotte. His army formed a curve from Buchholtz, the extremity of the left wing, through Mittenwalde, Klein-Beeren, Heinersdorf, Blankenfeld, Ruhlsdorf, to Belitz and Truenbriezen, the extreme right wing, from which the Russian line inclined inwards towards Juterbock; while the Prussians, in the centre, were advanced to Trebbin. The Prussian generals, Hirschfeld and Puttlitz, observed Magdeburg beyond Brandenburg. On both wings the light troops were dispersed as far as Wittenberg, Guben, and Baruth. On the 22d the enemy entered the curve—Regnier in the centre, Bertrand on the right, and Oudinot on the left wing. They attacked the Prussians at Trebbin, who gave way. On the 23d Bertrand fell upon General Tauenzien at Blankenfeld, but was repulsed. Regnier forced his way to Gross-Beeren, the key-stone of the arch, about 10 miles from Berlin. Here he was unexpectedly attacked by Bülow. At the same time Borstell surrounded the right wing of the enemy. The Prussians fought with great courage, in sight of their capital. A mounted Saxon battery having been outflanked and taken, they advanced to a charge. The discharge of fire-arms being rendered impossible by the rain, the soldiers fought with the butt-ends of their muskets and with bayonets. Gross-Beeren was taken by storm; the Saxon and the second French division were driven from the field, and the cavalry routed. Oudinot now brought up the three divisions of reserve, which were attacked by the Russians and Swedes as they deployed from the wood. Cardell, colonel of the Swedish forces, supported by an attack of cavalry, took the enemy's artillery. Oudinot now abandoned the struggle, and retreated to Wittenberg and Torgau on the Elbe. He lost thirty canons and more than 2000 prisoners. A pyramid of cast-iron has been erected on the spot by Frederick William III.

GROSSENHAIN, a town of Saxony, in the circle of and 20 miles N.W. of Dresden, capital of a district of same name, in a fertile valley on the left bank of the Röder. It was formerly fortified; has several fine public buildings, among which may be mentioned a church of an almost triangular shape, a town-house, with a lofty tower; poor-house, barracks, &c. Woollen and cotton goods are manufactured to some extent, and there are dye-works and print-fields, besides manufactures of starch, vinegar, and leather. The town has at various epochs suffered severely from fire, particularly in 1744. Pop. (1895), 12,024.

GROSSETESTE, Robert, an eminent English scholar and prelate in the early years of Henry III. He was born about the year 1175, studied first at Oxford, and then, like most of the theologians of that era, went to Paris, where he applied himself to the study of the Hebrew and Greek languages, of both of which he obtained the mastery. On his return to England he settled at Oxford, and became the first lecturer in the Franciscan school there. He soon acquired a great reputation for his linguistic abilities, his skill in logic, natural philosophy, medicine, and music, and his great knowledge of the Scriptures. In 1235 he was appointed Bishop of Lincoln, and at once commenced that reform of ecclesiastical abuses for which his name is now chiefly celebrated. Pope Innocent IV. had roused the indignation of Grosseteste by making grants of vacant benefices in England to Italians and other foreigners who never appeared in the country. A case occurred in 1253 which brought him into direct conflict with the holy see. The pope ordered Grosseteste to promote his nephew, an Italian youth, to the first canonry that became vacant in the cathedral of Lincoln. He indignantly refused, and according to some authorities was excommunicated; but, sustained by the general feeling of the English nation, Grosseteste paid no heed to the Papal thunderbolts, and continued to discharge his episcopal functions, revered and obeyed by his clergy as if nothing had happened, until his death in October, 1253. Lingard, however, has shown that the mandate came, not from the pope, but from the nuncio; and that Innocent, on receiving Grosseteste's reply, rescinded the order, and adopted measures for the reform of these abuses. Grosseteste is one of the most voluminous writers England has ever produced. In the biography of him published by Dr. Pegge (1793) the list of his works, few of which have been published, occupies twenty-five quarto pages.

GROSSULARIACEÆ, a natural order of exogenous plants, consisting of two genera and about 100 species. They consist of shrubby plants, either unarmed or spiny. They have alternate, lobed leaves; the calyx is either four or five parted, the tube entirely or in part adherent to the ovary; the petals are very small, alternate with the segments of the calyx; the stamens are alternate with the petals, and inserted into the throat of the calyx; the ovary is one-celled, with two opposite parietal placentæ. The fruit is a berry crowned with the remains of the flower, one-celled, the cell filled with pulp, in which the numerous seeds are immersed, and suspended by long threads. The plants are natives of most parts of the world except Africa and the tropics. The gooseberry, *Ribes Grossularia*, and the currant, *Ribes rubrum* and *nigrum*, are well-known fruits of this order.

GROSSWARDEIN, or Nagy-Varad, a town, Hungary, capital of county Bihar, in a beautiful but somewhat marshy plain, on both banks of the Körös, 38 miles S.S.E. from Debreczin. It consists of the town proper, formerly surrounded by walls and otherwise fortified, and of extensive suburbs, and is tolerably well built. It has three cathedrals—a R. Catholic, a Greek United, and a Greek Non-united, a synagogue, several nunneries, a theological seminary, gymnasium, academy of jurisprudence, &c. The staple manufacture is earthenware, and the trade is chiefly in it and in wine and other agricultural produce. There are marble quarries in the neighbourhood. Pop. (1890), 38,557; (1900), 50,177.

GROTE, George, historian and politician, was born in 1794 at Clay-Hill, Beckenham, Kent. His grandfather, descended from German ancestors, founded, in partnership with Mr. George Prescott, the London banking-house of Prescott, Grote, & Co. The future historian was educated first at Sevenoaks, and then at the Charterhouse, which he quitted in 1810 to enter as a clerk in the banking establishment, in which his father had now become a partner. He devoted all his leisure time to literature and to the study of economic science with James Mill and other leading members of the liberal school of politicians, with whom he became early acquainted. In 1821 he published a pamphlet on parliamentary reform in reply to an article by Sir James Mackintosh in the Edinburgh Review, and he afterwards wrote a treatise on the Essentials of Parliamentary Reform, besides contributing several articles to the Westminster Review. As early as 1823 he began to collect materials for his History of Greece, but he was to some extent drawn away from his task by the political excitement of the years 1830–32. In the latter year he was elected a member of Parliament for the city of London, and he attracted the attention of the house not only by his speeches on the currency and other kindred subjects, on which he could speak with peculiar authority, but also by his advocacy of the ballot. On the 25th April, 1833, he moved that 'it is expedient that in future elections of members to serve in Parliament the votes be taken in the way of ballot.' The motion was lost by 211 to 106. He was considered the parliamentary champion of the system of secret voting, and brought up the question for consideration, supporting it by powerful reasoning, session after session, until he withdrew from Parliament in 1841. From this date he devoted himself to his interrupted literary undertaking, and in 1846 appeared the first two volumes of his celebrated History of Greece. The remaining volumes followed in rapid succession: vols. iii. and iv. in 1847, v. and vi. in 1849, vii. and viii. in 1850, ix. and x. in 1852, xi. in 1853, and xii., the concluding volume, in 1856. The work terminates with the death of Alexander the Great, which, in the historian's opinion, is the close of Grecian history properly so called. An advanced liberal in politics, Grote laboured to counteract the influence of Mitford in Grecian history, and to construct a work from authentic materials which should illustrate the animating influence of democratic freedom on the human mind. In the prosecution of this task he has displayed an extent of learning, a variety of research, and a power of combination, which are worthy of the highest praise, and have secured for him a lasting place among the modern historians of Europe. His style is occasionally heavy, and some of his extreme views may be open to question; yet the work, with all these shortcomings, is a noble monument of erudition and genius. It has been translated into French and German. The definitive edition was published in 1888 (10 vols.). In 1865 he published a work entitled Plato and other Companions of Sokrates (3 vols.), and was engaged at the time of his death, which happened 18th June, 1871, on an equally elaborate treatise on Aristotle and the Peripatetics (published posthumously). His minor works have been edited by Prof. Bain. See Personal Life of George Grote, by Mrs. Grote (London, 1873).

GROTESQUES, in the fine arts, a term applied to capricious ornaments, which, as a whole, have no type in nature; consisting of figures, animals, leaves, flowers, fruits, &c., all mingled together, and so called from being found in the ancient *grottoes*. Some artists make a distinction between grotesques and arabesques, the latter style of ornamentation being confined to strange combinations of fruits and flowers, while in grotesques real or fancied forms of animal and plant life may be introduced. The origin of these fantastic compositions is traced by Böttiger to the carpets of Persia and India, ornamented with all the wonders of oriental fable.

GROTIUS, or DE GROOT, HUGO, a scholar and statesman of the most diversified talents, was born at Delft, April 10, 1583. At the age of eleven he was sent to the then newly established University of Leyden, of which his father, Jan de Groot, was curator, and where he studied under Joseph Scaliger. In his fifteenth year he sustained, with general applause, theses on philosophy, mathematics, and law. The next year he accompanied Barneveldt, the Dutch ambassador, to France, where he gained the approbation of Henry IV. by his genius and demeanour, and was everywhere admired as a prodigy. After his return he conducted his first lawsuit in his seventeenth year; and in his twenty-fourth was appointed advocate-general. In 1613 he became syndic, or pensionary, of Rotterdam. In 1615 he was sent to England in order to arrange the difficulties arising from the claims of the English to exclude his countrymen from the Greenland whale-fishery. The negotiations came to nothing; but while in England Grotius succeeded in forming an intimate and lasting friendship with Isaac Casaubon. The disputes of the Remonstrants and their opponents then disturbed the tranquillity of Holland. (See ARMINIANS.) Barneveldt was the defender of the former party. Grotius, who had declared himself on the side of Barneveldt, supported him by his pen and influence. This involved him in the trial which terminated in the beheading of Barneveldt in 1619, and the condemnation of Grotius to imprisonment for life in the fortress of Lovestein. He succeeded in escaping from this fortress by concealing himself in a chest in which his wife had sent him books. After wandering about for some time in the Catholic Netherlands, he escaped to France. Louis XIII. gave him a pension of 3000 livres. The Dutch ambassadors endeavoured in vain to prejudice the king against him. Richelieu, however, was unfavourably disposed towards him, and in 1631 his pension was withdrawn. Grotius then returned to his native country, relying on the favour of Frederick Henry, prince of Orange, who had written him a sympathizing letter. But, by the influence of his enemies, he was condemned to perpetual banishment. Grotius next proceeded to Hamburg. During his residence in that city the Kings of Denmark, of Poland, and of Spain, made attempts to persuade him to settle in their states; but the protection which the chancellor Oxenstiern promised him, and the inclination of Queen Christina for learning, induced him to accept the offers of this princess. In 1634 he went to Stockholm, where he was appointed counsellor of state and ambassador to the French court. This choice displeased Cardinal Richelieu, who was irritated to see a man return who had been denied protection and a residence in France; but Oxenstiern would not allow any other minister to be nominated, and Grotius appeared at Paris in 1635. He discharged his duties as ambassador for ten years, and gained universal respect. On his return to Sweden by the way of Holland he met, in Amsterdam, with the most honourable reception. Most of his enemies were dead, and his countrymen repented of having banished the man who was the honour of his native land. He was received with equal favour by the queen in Sweden. He afterwards requested his dismission, and, having finally obtained it, was on his way to Holland, when a storm drove him to Pomerania. He fell sick at Rostock, where he died, August 28, 1645. With the talents of the most able statesman, Hugo Grotius united deep and extensive learning. He was a profound theologian, excellent in exegesis, his Commentary on the New Testament being still esteemed; a distinguished scholar, an acute philosopher and jurist, and a judicious historian. His writings have had a decisive influence on the formation of a sound taste, and on the diffusion of an enlightened and liberal manner of thinking in affairs of science. As a critic and philologist he seizes the genius of his author with sagacity, illustrates briefly and pertinently, and amends the text with facility and success. His metrical translations from the Greek are executed with the spirit of a poet. Among the modern Latin poets he holds one of the first places, and he also tried his powers in Dutch verse. But the philosophy of jurisprudence has been especially promoted by his great work on natural and national law, De Jure Belli et Pacis, which laid the foundation of a new science; besides which he wrote Annales et Historiæ de Rebus Belgicis; Annotationes in Vetus Testamentum; Annotationes in Novum Testamentum; De Veritate Religionis Christianæ, and Poemata (Leyden, 1617, 12mo).

GROTTA DEL CANE (*Dog's Cave*), the most remarkable of the many grottoes around Naples, mentioned even by Pliny (lib. ii. c. 90), hollowed out of a limestone rock, from which carbonic acid gas is copiously evolved. The gas, in consequence of its weight, remains principally at the lower part, so that a man, having his head above the level of the gas, is not affected by it; whereas a dog, which is commonly employed to exhibit its effect, at first struggles considerably, but becomes asphyxiated in about two minutes, and is only recovered by being immediately withdrawn into the open air. See CARBON.

GROUCHY, EMMANUEL, MARQUIS DE, a marshal and peer of France, born at Paris in 1766, served at the commencement of the French revolution in the Royal Life Guards. Inclined to constitutional forms, he quitted that body, entered the cavalry, and in 1792 was colonel of Condé's regiment of dragoons. He afterwards acquired distinction in the revolutionary armies, and at the battle of Novi, in 1799, where he commanded the left wing, was severely wounded and taken prisoner. In the campaign of 1800 he fought in the army of the Rhine under Moreau, and rendered important service at the battle of Hohenlinden. His friendship for Moreau cost him the favour of Napoleon, and for some time after the Peace of Luneville he remained without employment. In the war with Prussia in 1806, and with Russia in 1807, he acquired new fame, and after a short stay in Spain was sent to the army of Italy under Prince Eugene. At the battle of Wagram his masterly manœuvres contributed greatly to the victory. In the Russian campaign of 1812 he commanded one of the three cavalry corps, besides several divisions of infantry, and fought with distinction at Krasnoi, Smolensk, and on the Moskwa. On the retreat Napoleon intrusted him with the command of the Sacred Battalion, so called because composed of officers for his personal security. In the campaign of 1813 he remained without an appointment. When the allies entered France he took the command of the cavalry, and was severely wounded at Craon. On the restoration he was banished, but permitted to return in 1815. On Napoleon's return he immediately joined him, was made a marshal, and obtained first the command of the army of the Alps, and then the command of the cavalry in the grand army. After the battle of Ligny he was sent on the following day with 34,000 men and 100 cannon to follow the retreat of the Prussian army under Blücher. While he here on the 18th engaged with Thielemann, Napoleon gave battle at Waterloo, the disastrous issue of which has been sometimes laid to Grouchy's charge, from having failed to observe how three divisions of the Prussian army were advancing to Waterloo to take Napoleon in flank and rear, while Thielemann alone remained at Wavres. On the abdication of Napoleon he proclaimed his son as Napoleon II., and

sent the cavalry to collect the remains of the army at Laon and Soissons, while he retired with the infantry to Rheims. Having been named commander-in-chief of all the corps of the grand army, he came to Soissons, and then placed himself under the walls of Paris with a body 45,000 strong. When negotiations commenced he resigned his command and withdrew. Being again banished, he proceeded to North America, but was permitted to return in 1819, and lived as a disposable general on his estate of Ferrière, near Caen. After the July revolution he was elected to the chamber of deputies by the department of Allier, supported the new dynasty, and was appointed in 1831 marshal, and in 1832 a peer. He died in 1847 at St. Étienne, while returning from a tour in Italy.

GROUND, in the fine arts, is a word of various application. In painting it is the first layer of colour, on which the figures or other objects are painted. The works of the Italian school preceding and during the time of Raphael were all painted on white grounds. The preparation was composed of plaster of Paris or chalk mixed with size, and the ground was of course absorbent. These paintings were almost always executed on panels; but afterwards, when canvas came into general use, the works of the Italian and Spanish schools were in most cases painted on an oil ground of a dull red colour. The Dutch and Flemish masters painted on light grounds varying from white to gray, and their example has been followed by the English painters and those of the modern continental schools. The term is also applied to the different distances in a picture—as the *fore-ground*, on which are placed the figures or objects represented as nearest the spectator; the *back-ground*, or that portion of the ground on which it is intended to set off or relieve the figure or group depicted.—In sculpture it is the surface from which, in reliefs, the figures rise.

GROUND-RENT, in English law, is the rent paid to the landlord by a person for the use of ground on which he intends to build. The usual arrangement is for a specified time, generally ninety-nine years. On the expiry of this period the whole of the building becomes the property of the ground-landlord. The ground-landlord is able, when his rent is in arrear, to distrain all the goods and chattels found on the premises, to whomsoever they may belong; and as the ground-rent is generally a small sum compared with the furniture of a tenant, he is always certain of recovering its full amount. This power of distress exists whether the tenant has paid his house-rent to his landlord or not, but the tenant may deduct the amount from the next rent he pays. *Feu-duty* is the corresponding term, in Scotch law, to ground-rent, with the difference that feu-duty lasts for ever, there being no period fixed for its expiring.

GROUNDSEL (*Senecio vulgaris*), a weed belonging to the natural order Compositæ; the stem is fistulous, about 1 foot high; the leaves amplexicaul and sinuate-pinnatifid; the flowers small, yellow, destitute of any ray, and disposed in a loose corymb. The plant is emollient, has an herbaceous and slightly acid taste, but is rejected by almost every quadruped except the hog and goat; small birds, however, are very fond of the seeds.

GROUND-SQUIRREL. See SQUIRREL.

GROUND TACKLE, a general name given to all sorts of ropes and furniture which belong to the anchors, or which are employed in securing a ship in a road or harbour—as cables, anchors, bow-lines, &c.

GROUP (Italian, *groppo* or *gruppo*), a term employed, in painting and sculpture, to signify an assemblage of several objects, such as figures of men, beasts, fruits, or the like, which have some relation to each other, arranged in such a manner as to present to the eye one connected whole.

GROUSE. The various species of grouse constitute a large sub-family of birds (*Tetraonidæ*, from the principal genus *Tetrao*), whose distinguishing mark is a naked band, often of a red colour, in place of an eyebrow. They are wild, shy, and almost untamable. They live in families, dwelling in forests and barren regions, far from man and cultivation. They feed exclusively on berries, buds, and leaves. They are polygamous, the male abandoning the female, and leaving to her the whole care of the progeny. The eggs number eight to fourteen. See illustrations at the article ORNITHOLOGY.

The largest species is the *Capercailzie* or *Wood Grouse* (*T. urogallus*). This is superior in size to the turkey. It lives in pine forests, feeding on the cones of the fir, which at some seasons give an unpleasant flavour to its flesh. This bird became extinct in Britain, but has been reintroduced from Norway, and prospers where it is well preserved.

The *Black Grouse* (*T. tetrix*) is about the size of a common fowl, though it is much heavier. The male has the outer feathers of the tail curved outwards, so that the tail is lyre-shaped. It chiefly lives in high and wooded situations, feeding on various kinds of berries. It does not pair, but, on the return of spring, the males assemble in great numbers, when a contest for superiority ensues, and continues with great bitterness till the vanquished are put to flight.

There are several species peculiar to North America, the most remarkable of which is the *Pinnated Grouse* or heath hen (*T. cupido*). This curious bird inhabits open desert plains in particular districts of the Union, avoiding immense intermediate regions. The male is furnished with wing-like appendages to his neck, covering two loose, orange sacs, capable of being inflated. Its favourite food is the partridge berry, though it is also fond of whortleberries and cranberries. It commonly unites in coveys until the pairing season. The other American species are the *Dusky Grouse* (*T. obscurus*), inhabiting the Rocky Mountains; *Canadian Grouse* (*T. Canadensis*), peculiar to the northern and north-western parts of the United States, more common in Canada; *Long-tailed Grouse* (*T. phasianellus*), inhabits the western wilds of the United States beyond the Mississippi. The *Cock of the Plains* (*T. (Centrocercus) urophasianus*, Bp.), also an American bird, has the tail feathers sharp, lancet-like, and those of the breast also rigid.

The foregoing belong to the genus *Tetrao*, as restricted to those birds which have the toes covered with horny plates and only rudimentary feathers on the feet. The *Hazel Grouse* (*Bonasa sylvestris*) in North Europe, and the *Ruffed Grouse* (*B. umbellus*) of N. America have the toes and lower part of the tarsus naked, and elongated feathers on the upper part of the head. The latter species, the partridge of the U. States and pheasant of Pennsylvania, is well known in almost every quarter of the United States. Its favourite places of resort are high mountains, covered with the balsam pine, hemlock, &c.; it is seldom found in open plains. The manners of this bird are solitary, being usually found in pairs or singly. It generally moves along with great stateliness, with the tail spread out like a fan. The male makes a peculiar noise termed *drumming*. This is done by rapidly striking with his stiffened wings; it is most common in the morning and evening. It pairs in April and lays in May. The eggs are from nine to fifteen in number. It is in best order for the table in September and October.

The *Sand Grouse* (*Pterocles*), and the *Prairie Hen* (*Syrrhaptes*), of the Asiatic table-lands, constitute another family (*Pteroclidæ*).

The birds with hairy feet (that is, with the toes feathered) form the genus *Lagopus*. Of these the *Red Grouse* (*Lagopus Scoticus*) is the most important. This bird is also called *moorfowl*, and is found in great plenty in the Highlands of Scotland. It is found also in Wales, the north of England, Ireland, and the Scottish islands, and consequently the specific name of *Scoticus* is somewhat of a misnomer. It does not occur outside of Britain, but is represented in some other countries by the Willow Grouse (*L. albus*). It pairs in the spring; the female lays eight or ten eggs. The young follow the hen the whole summer. As soon as they have attained their full size they unite in flocks of forty or fifty, and are extremely shy and wild. This bird, as is well known, attracts large numbers of sportsmen every August to the Scottish moors to take part in the grand sporting campaign which follows 'the twelfth'. The rage for renting a grouse-moor in Scotland, like that for deer-forests, became prevalent from the middle of the nineteenth century. (See DEER-FORESTS.) The grouse disease is an epidemic which at certain seasons causes great destruction among the grouse of Britain. It is a sort of infectious pneumonia, produced or accompanied by the presence of certain bacteria or bacilli in the system. The disease usually does most havoc in May and June, but a milder form appears in autumn. Grouse are also liable to suffer from some other diseases caused by internal parasites.

Ptarmigan or *White Grouse* (*Lagopus mutus* or *vulgaris*). This and the preceding, along with the capercailzie, are the only British species of grouse. The ptarmigan occurs also over a wide area of Europe and Asia. The bird is ash-coloured in summer, but its hue changes to a pure white in winter. It seems to avoid the solar heat, and prefers the cold on the tops of mountains, for as the snow melts on the sides of the mountains it constantly ascends. The flesh is dark coloured.

GRUB, the term generally applied to the fleshy, worm-like larvæ of coleopterous and other insects, especially such larvæ as have no legs. Some species of grubs are particularly obnoxious to the farmer and gardener from the injury they do to the roots of plants. See LARVA, BEETLE, MOTH, &c.

GRUBBER, an agricultural implement used for tearing up and loosening the soil and clearing it of weeds, and consisting of a number of teeth or tines set in a frame, the teeth being curved so as to enter the soil obliquely, and the frame being provided with handles and wheels, having often one of the latter in the front and two behind. See AGRICULTURE.

GRÜNBERG, a town in the Prussian government of Liegnitz, Silesia, finely situated in a healthy district 15 miles east of Giessen. Besides several churches, it has a town-house, hospital, orphan asylum, schools, &c. It manufactures a great quantity of broad-cloth, straw-hats, leather, tobacco, paper, glass, textile and other machinery, &c. The town is surrounded by vineyards, which produce large quantities of wine. Pop. (1900), 20,983.

GRUS. See CRANE.

GRUYÈRE, a village of Switzerland, in the canton and 16 miles south of Fribourg, on a hill crowned by a fine old feudal castle. It gives its name to the well-known cheese, of which large quantities are made in the surrounding districts.

GRYLLUS. See CRICKET (the insect).

GRYPHIUS, ANDREAS, a German dramatic poet, was born in 1616, at Glogau. He studied at Fraustadt and Dantzig, and acquired an extensive knowledge of law; after which he became tutor in the house of the Count Palatine Georg von Schönborn. He passed ten years in travelling through Holland, France, and Italy, during which he formed friendships with many of the most eminent men of the age. On his return he became syndic to the senate of Glogau. He died suddenly (1664) in an assembly of the estates. Gryphius did much for German literature. At a time when there were no German dramas but the carnival plays he wrote tragedies and comedies which displayed his acquaintance with ancient and modern literature, and contained many poetical passages, though they showed no acquaintance with theatrical effect. Many of his other poems breathe a high lyric spirit, mixed with a tone of melancholy, occasioned by intense physical and mental suffering.

GUACHARO (*Steatornis Caripensis*), a fissirostral bird of the family Caprimulgidæ or goat-suckers. It is a nocturnal bird, a native of South America, and is found in great numbers in the Cave of Guacharo, in Venezuela, described by Humboldt. The bird is about the size of a common fowl, with a curved and toothed bill; the colour is a ruddy fawn mottled with dark brown, and spotted here and there with square white marks; the spread of the wings is about 3½ feet. Their food is principally seeds and hard fruits, upon which they grow so fat that the Indians kill great numbers for the sake of their oil, which they use in preparing their favourite dishes. The clarified fat is half-liquid, transparent, inodorous, and will keep for a year without becoming rancid. The Guacharos would have been exterminated long ago but for the superstitious fears of the natives, who do not dare to penetrate far into the caves in which they build. The hard and dried fruits found in their crops and gizzards are considered excellent remedies against the intermittent diseases of the country.

GUADALAJARA, a town of Spain, capital of the province of same name, on the left bank of the Henares, here crossed by a fine bridge of stone, 14 miles north-east of Madrid. It is substantially built, consists of several well-paved streets and squares, and has several churches and convents, an ancient court-house, a large palace of the Duke del Infantado, now used as a school for the orphan sons of officers, a fine museum, library, and gymnasium, several hospitals, and a Roman aqueduct, which still supplies the town with water. The manufactures are flannel, serge, chocolate, and flour, and the trade is chiefly in these, and in grain, fruit, silk, &c. Pop. (1897), 11,513.—The province, area 4870 square miles, is bounded on the N. by Segovia, Soria, and Saragossa, on the E. by Saragossa and Teruel, on the S. by Cuenca, and on the W. by Madrid. The surface is mountainous in the east, and particularly in the north, but elsewhere consists of an elevated plateau. The principal rivers are the Tagus, Tajuña, Henares, and Jarama. The soil varies much in different districts, and is particularly fertile in the district of Alcarria. The minerals include iron in abundance, lead in limited quantity, and, it is said, coal. Pop. (1897), 199,290.

GUADALAJARA, GUADALAXARA, department of Mexico. See JALISCO.

GUADALAXARA, or GUADALAJARA, a city of Mexico, capital of the state of Jalisco or Guadalaxara, on the left bank of the Rio de Santiago; 275 miles W.N.W. of Mexico, and about 140 miles from the Pacific Ocean. It is a large and handsome city, the streets spacious, and the houses excellent. There are fourteen squares, twelve fountains, and a number of convents and churches. In the Plaza Mayor is seen the cathedral, a magnificent structure, although its appearance has been much impaired by the destruction of the cupolas of both its towers by the great earthquake of 1818; on the right side of the same

square is the government house, in a noble and severe style, and with a fine façade; and the arcades, which line the two sides of the square, are very handsome, and are filled with elegant and well-stocked shops, in which almost every description of European and Chinese manufactures may be obtained. The *Alameda* or public walk is beautifully laid out with trees and flowers, with a fountain in the centre, and a stream of water all round. Various trades are carried on with success, particularly those of the blacksmith, carpenter, and silversmith. There are also manufactures of shawls of striped calico, of paper, and of a particular description of earthenware, and great skill is displayed in leather working. The foreign trade of the place, now very trifling, was formerly carried on through the port of San Blas, on the Pacific, but is now removed to the superior harbours of Mazatlan and Guaymas. Guadalaxara was founded in 1551 and in 1570 was created an episcopal city. Pop. (1900) 101,208.

GUADALQUIVIR (ancient *Baetis*), a river, Spain, which rises in the frontiers of Murcia, in the Sierra Sagra, traverses Andalusia from north-east to south-west, passing the towns of Andujar, Villafranca, Cordova, and Seville, at the last of which it forms the islands of Ila Minor and Major, and thereafter flowing S.S.W., falls by a broad estuary into the Atlantic at the town of San Lucar de Barrameda. Its course is 250 miles, of which 70 miles, commencing at Seville, are navigable, and its basin extends over an area about 300 miles long by 125 broad. Its chief affluents are, on the right, the Guadalimar, Guadiel, Rumblar, Escobar, Jandula, and Yeguas, and on the left, the Guadianamenor, Jandulilla, Guadulbullon or Jaen, and Salado de Porcuna. In the lower part of its course, through a flat and fertile country, it often commits great ravages by inundation. It abounds with fish.

GUADELOUPE, a government of the French West Indies, including the islands of Guadeloupe, Marie Galante, les Saintes, Desirade or Deseada, St. Barthélemy, and St. Martin. The island of Guadeloupe lies between lat. 15° 47′ and 16° 30′ N., and lon. 61° 15′ and 61° 45′ W. It is composed of two portions or distinct islands, separated by an arm of the sea called Rivière Salée (salt river), from 30 to 100 yards broad, and navigable for small vessels. The western and larger portion is Guadeloupe Proper, divided into Bassesterre, and Capesterre, and is 27 miles long by about 15 miles broad. The eastern portion, called Grande-terre, is nearly 30 miles long by 10 to 12 miles broad. Guadeloupe Proper is of volcanic formation, and is traversed north to south by a ridge of hills, having a medium height of 2296 feet. The culminating points are La Souffrière, an active volcano, 5108 feet high; La Grosse-Montagne, les Deux Mamelles, and le Piton-de-Bouillante, extinct volcanoes. Grande-terre, on the other hand, is generally flat, composed of madrepores and marine detritus, and nowhere rises higher than 115 feet above the sea. Guadeloupe is watered by a number of small streams, running in deeply cut beds, but becoming dry in summer; the principal are the Goyaves, Lamentin, and Lezarde, which are navigable for canoes. Grande-terre has only a few springs of brackish, undrinkable water. The climate is hot and unhealthy, the mean temperature being 79°, the ordinary extremes 71° and 97°, and the greatest heat 130°, accompanied with a remarkably humid atmosphere. Hurricanes are frequent and destructive, but the earthquake of 1843, which completely destroyed the town of Point-à-Pitre, and partly ruined the colony, was the first severe one known since the discovery of the island. The soil is fertile and well cultivated, covered with fine forests in the mountainous, untilled parts, and with mangroves and manchineel trees on the marshy coast of Basse-terre. The produce is similar to that of the other West Indian Islands; the Tahiti sugar-cane is the only kind cultivated. The chief articles of export, sent almost all to France, are sugar, coffee, dye and cabinet woods, rum, tafia, cotton wool, annatto, hides, sweetmeats and preserves, copper, tobacco, &c. Imports, cotton manufactures, hides, wheatmeal, salted butter, codfish, olive-oil, wax candles, pottery, glasswares, salted meat, medicines, &c.

Guadeloupe was first discovered by Columbus in 1493, and was named by him in honour of Santa Maria de la Guadeloupe. It was taken possession of by the French in 1635, who kept it till 1759, when it was taken by the English. It was finally ceded to the French in 1814. Basse-terre is the capital, but Pointe-à-Pitre, the chief port, is the largest town. Pop. in 1901, 172,097.

GUADIANA (ancient *Anas*), a river which rises in the plateau of New Castile, Spain, flows first north-west, then circuitously south-west into Estremadura, crosses that province, and on reaching Badajoz begins to turn S.S.W. and form part of the boundary between Spain and Portugal. Entering that kingdom, it flows past Monsaras, Moura, and Serpa, to Mertola, again forms the boundary between the two kingdoms, and falls into the Atlantic between Castro Marim on the Portuguese, and Ayamonte on the Spanish side. Its course is above 400 miles, of which only 35, commencing at Mertola, are navigable; its basin is 373 miles long from north-east to south-west, by 125 miles broad. Its chief affluents are, on the right, the Gigüela, Bullaque, Valdehornos, and Rubial, and on the left, the Azuel and Jabalon.

GUADIX (ancient *Acci*), a town, Spain, Andalusia, in the province and 31 miles E.N.E. of Granada, on the north slope of the Sierra Nevada, above a river of its name. It is surrounded by ancient walls, and is said to be the first bishop's see erected in Spain. The houses are generally antiquated, but among the public edifices are a handsome cathedral, another fine church with an elegant portal and tower, a court-house, an hospital, occupying the buildings of a Jesuit College, and a finely situated old castle, almost in ruins. The manufactures are hempen goods, hats, earthenware, and saltpetre, and the trade is in silk, wool, flax, cotton, and liqueurs. Pop. (1897), 12,100.

GUAIACUM, a genus of plants, belonging to the natural order *Zygophyllaceæ*, and containing four or five arborescent species, natives of the West Indies and the tropical parts of America. All the Guaiacums are well known for their exciting properties; according to Lindley the bark and wood of *G. sanctum* and *officinale* have a somewhat bitter and acrid flavour, and are principally employed as sudorifics, diaphoretics, or alteratives; they contain a resinous substance called guaiacum resin, for which see next article. The medical value of guaiacum is said to reside chiefly in the bark. The foliage yields a detersive substance which is used in the West Indies, in preference to soap, for scouring and whitening floors. The wood is exceedingly hard, of a pale yellow colour near the exterior, and blackish brown at the heart; specifically heavier than water; and is well known under the name of *lignum-vitæ*. It is used for the wheels and cogs of sugar-mills, for pulleys, bowls, and a variety of ornamental articles of furniture, being susceptible of a fine polish. The tree has now become scarce in Jamaica and St. Domingo, large quantities having been cut down for exportation.

GUAIACUM RESIN is obtained from the *G. officinale*, either by its flowing spontaneously from the tree, or from incisions or perforations in the stem, or by extraction by means of spirit from the wood.

It forms either rounded drops or tears about the size of a nut, or angular masses, greenish externally and covered with powder, yellowish or brown internally, translucent or transparent, with a conchoidal fracture. It has a pleasant odour, the taste is somewhat bitter and pungent, it fuses readily and dissolves freely in spirit, but is insoluble in water. It is especially distinguished by its sensitiveness to the action of oxidizing agents, its colour changing to green or blue by contact with the very smallest quantities of these bodies, and being restored to yellow again by reducing agents. Guaiacum resin is by no means a single substance, but seems to be a mixture of various resinous acids, a yellow colouring matter, a definite resin, mineral matter, and perhaps other constituents. The chief use of guaiacum is in medicine, the resin as a whole being used. The chief preparations are the tincture, a solution of the resin in spirit, and also the resin in powder along with other drugs, as in the compound calomel pill, and guaiacum mixture. It is employed as a stimulant in chronic rheumatism, and is used also in gout, scrofula, and syphilis, in cases of quinsy, sore throat, chronic catarrh, &c. Guaiacum seems to have been employed for therapeutic purposes as early as the sixteenth century.

GUAIRA. See GUAYRA.

GUAM, also GUAHAN, the most southerly and the largest of the Ladrones, or Marianne Islands, having a length of 32 miles and a circumference of about 100. It is well watered and fertile, and has a population of about 9000, about one-third of whom reside in Agaña, the capital. Rice, sugar, cocoa, and indigo are produced. In 1898 Spain ceded the island to the United States.

GUAMANGA. See AYACUCHO.

GUAN, a gallinaceous bird of the family Cracidæ, genus *Penelope*. In this genus the bill is shorter than the head, broad at the base, arched at the tip; wings short and rounded; tail long and very broad, and rounded at the end; the sides of the head and front of the throat naked and wattled, the wattles capable of inflation. The name guan is more particularly applied to the *Penelope cristata*, the largest bird of the genus, measuring about 30 inches, the tail being 13 or 14 inches; the colour is a shining reddish-green, with rump and belly chestnut, neck and chest white-spotted, naked temples violet, and the feet and throat red; the female is of a more reddish tint, with the crest, neck, and mantle bordered with white. Though the guans have most of the habits of the curassow, they are far less gregarious, being generally seen singly, in pairs, or in small bands; they are more noisy and restless, and have two broods in a year, about January and June; the nests are built on trees, and the young are led and protected as by the domestic hen. They perch on trees, descending in search of grain and fruits. The guans are natives of the forests of Brazil and Guiana, and have been long domesticated in South America. They have been frequently carried to Europe, and with a little care would make a valuable addition to the farmer's stock of poultry in Britain.

GUANACO. See LLAMA.

GUANAHANI. See CAT ISLAND.

GUANAXUATO, a state situated in the centre of Mexico, bounded N. by San Luis Potosi, E. by Querétaro, S. by Michoacan, and W. by Jalisco or Guadalaxara; about 100 miles long by as many broad; area, 11,370 square miles. Its mines, once the richest in the world, are still worked to a considerable extent, and yield a large amount of gold and silver. After these metals, the only export of any importance is spices. The surface is traversed by the cordillera of Anahuac, which attains the height of 9711 feet, but in the south-west there is a fertile plain. The chief river is the Rio Grande de Santiago. There are now some manufactures of pottery, leather, &c. Pop. (1900), 1,065,317.

GUANAXUATO, or SANTA FE DE GUANAXUATO, a city of Mexico, capital of the state of the same name; 160 miles north-west of Mexico. It is situated in a narrow defile, hemmed in by mountains, at the height of 6836 feet above the sea. It has steep, irregular streets, but the houses, particularly those belonging to the proprietors of the neighbouring mines, are well built. It contains a cathedral and several elegant churches and other religious edifices, a mint, a university, a theatre, a gymnasium, several other schools, &c. The mines of Guanaxuato are the most productive in Mexico. Pop. (1900), 41,486.

GUANCHES, the aborigines of the Canary Islands. The Spaniards, who first took possession of these islands in the fifteenth century, describe the inhabitants as very tall, with olive complexion, hospitable, peaceful yet brave. They tilled the ground with rude implements,, and for food used barley, wheat, and goats' milk. They believed in a good and an evil spirit, and a future state, the place of torment for the bad being supposed to be in the volcano of Teneriffe. They preserved the bodies of their dead and deposited them in catacombs, which are now visited among the curiosities of the islands. Their speech, of which no more than 150 words are known, seems to have been one of the dialects of the Berber language. Although they must have originally come from the neighbouring continent, the Spaniards on first landing found them possessed of no canoes, so that there was no intercommunication with the various islands. They submitted to the Spanish yoke only after a hard struggle. Many of them were sold into slavery or were destroyed by pestilence; the remaining few got intermixed with the Spaniards, ceased to talk their own language, and became extinct as a people about the beginning of the seventeenth century.

GUANO (Peruvian *huano*, dung) is the name for deposits of the partially decomposed and dry excrementitious matter of sea-birds, but it has been also extended to accumulations of a similar kind from land birds, and even from bats in caverns. Deposits from sea-birds are got wherever there is good feeding-ground in the neighbourhood of unfrequented islands and rocky cliffs, and such may be seen round many shores. But to render them of practical utility atmospheric conditions are requisite which are only found in certain localities, and all the great guano deposits exist in the hottest and driest parts of the tropics, as on the islands of the South Pacific Ocean. The most important of all were the deposits on the Chincha Islands off the coast of Peru, which for years yielded a considerable revenue, but are now quite exhausted. The guano which was found there was from 60 to 80 or 100 feet in thickness, and was entirely due to the droppings, accumulated for many ages, of the innumerable sea-birds which make these islands their resting-place and breeding-ground. The excrement, which is at first pasty, rapidly dries by exposure to the sun in a part of the world where a fall of rain takes place once in a lifetime, and is looked upon as an historical event, and thus, while putrefaction is almost entirely arrested, the soluble salts of which guano to a great extent consists are retained. This guano, called technically Peruvian, is the most highly prized, and is regarded as a type of the substance; but quantities are or have been got from other localities, as Patagonia, various points of Bolivia, Mexico, and Chili, Malden Island and numerous other Pacific islands, new deposits being opened up as the older become less productive.

Guano varies extremely in composition, even in the same deposit considerable differences will be found; and when deposits from different localities are compared, there is sometimes no analogy except in the kind of substances present. Thus, some consist mainly of phosphate of calcium and other fixed salts, while others contain much volatile matter, containing a large proportion of ammonia. To the latter belongs Peruvian guano, which is a very light, dry, non-cohesive pale-yellow powder, with a characteristic ammoniacal odour, and sometimes containing lumps, made up of different salts. It is a very complex mixture, containing the urate of ammonium, the oxalates of ammonium and calcium, the phosphates of sodium, ammonium, calcium, and magnesium, the sulphates of potassium, sodium, and ammonium, the chlorides of sodium and ammonium, and the carbonate of calcium. There is always some moisture, organic matter of different kinds, sand from the rock on which the deposit lies, and this is sometimes considerable. These may be regarded as the possible constituents of guano, but the ingredients which are especially prized are the ammoniacal salts, the phosphoric acid, in combination with the alkalies and alkaline earths, and the alkalies themselves, particularly the potash. It is the remarkable abundance of these constituents and their fine intermixture which makes genuine Peruvian guano so much esteemed as a manure. It contains almost all the inorganic matter required by a plant, and that in a highly available form, so that it is one of the best of all fertilizing agents for different crops. Its use as a manure was known to the native Peruvians centuries ago, but no attention was paid to the accounts by modern travellers of its wonderful efficacy until A. von Humboldt brought some to Europe and had it analysed. It was not imported on a large scale till about 1850, and from that time the quantity brought was very great, but the supply has latterly much fallen off.

As a substitute for ordinary guano what is known as *fish-guano* has been in use for a considerable number of years. This consists essentially of fish and fish offal dried and powdered. In the case of oily fish, such as herrings, it is necessary to extract as much of the oil as possible before the operation of powdering; and it will thus be understood that different kinds of fish differ greatly as regards their value for manurial purposes. But all sorts of fish-guano contain a large percentage of ammonia and phosphate of lime, and are thus valuable as fertilizers.

GUANTA, a seaport on the north coast of Venezuela, in the state of Bermudez, 12 miles north-west of Barcelona, to which there is a railway. The port, which is of recent origin, has anchorage for ships of all sizes.

GUAPORE, or ITENEZ, a river of South America, which rises in the Serra Aguapehi, in the Brazilian state of Matto Grosso, flows south, nearly parallel to the Jauru, passes the town of Matto Grosso or Villa Bella, flows N.N.W., then W.N.W., forming part of the boundary between Brazil and Bolivia, and finally, after a course of about 1000 miles, unites with the Mamore in forming the Madeira. Its navigation is much interrupted by cataracts.

GUARANA BREAD, the seeds of the *Paullinia sorbilis* (a South American tree), pounded, made into cakes, and dried in the sun. It is extensively used in Brazil, Guatemala, Costa Rica, and other parts of South America as a stimulant and restorative, and as a material for making a refreshing beverage. The active principle of guarana is said to be identical with theine; and no known substance yields it so abundantly. Other species of *Paullinia* possess poisonous properties.

GUARANTEE, or GUARANTY, in law, an undertaking to answer for the failure of another. The Statute of Frauds provides that no person shall be liable on any special promise to answer for the debt, default, or miscarriage of another person, unless a written agreement, or some memorandum in writing for such purpose, shall be signed by the promiser or some other party lawfully authorized by him. In the construction of a guarantee it is a general rule that the surety shall not be bound beyond the express words of the engagement. By the Mercantile Law Amendment Act (England and Ireland), 19 and 20 Vict. cap. xcvii., no special promise made to answer for the debt, default, or miscarriage of another is deemed invalid to support an action, by reason that the consideration for such promise does not appear in writing, or by necessary inference from a written document. By a similar statute applying to Scotland, and passed in the same year, all such guarantees must be in writing, and if for a firm will cease upon a change of the members, unless intended by the parties by express stipulation or implication to be binding notwithstanding the change in the firm. Every person who becomes surety for the debt or obligation of another, and discharges his liability, is entitled to the assignment of all securities held by creditors.

GUARDAFUI, CAPE, or RAS JERDAFOON (the ancient *Aromatum Promontorium*), the most eastern point of Africa, at the entrance of the Gulf of Aden, forming the north-eastern extremity of the Somali country. It is dangerous to shipping.

GUARDIAN, in law, he who has the custody of such persons as are incapable of directing themselves, and especially of infants. They may now be said to be of five kinds: 1st, testamentary, or appointed by will; 2nd, customary, by local usage; 3rd, *ad litem*, or appointed by a court in order to conduct legal proceedings; 4th, by appointment of chancery; and 5th, in tort, or by intrusion, as when a person wrongfully intrudes in the management of an infant's estate, he must account in chancery as if he had been a guardian. In Britain, guardianship lasts in the case of infants until they have attained the age of twenty-one. The power and reciprocal duties of guardian and ward are the same, during the infancy of the ward, as that of a parent and child; with this difference, that the guardian, when the ward comes of age, is bound to give him an account of all transactions on his behalf, and must answer for all losses by his wilful default and negligence.

GUARDIANS OF THE POOR, in England, are persons elected by a parish to manage the affairs of the poor. The guardians have the management of the workhouse, and the maintenance, clothing, and relief of the poor. Their duties are regulated by statutes. The appointment of such guardians now takes place under the Parish Councils Act of 1894. In rural parishes they are not elected as a separate body, but the district councillors act as guardians; in urban parishes the guardians are still elected as such; the electorate in both cases including occupiers, owners, lodgers, and service voters.—In Scotland the Parochial Boards acted as guardians of the poor till superseded by the Parish Councils in 1895.

GUARDS, troops whose particular duty is to defend the person of a civil or military ruler. In modern times the term *guard* has been used to designate corps distinguished from the troops of the line by superior character, or only by rank and dress. The interest of the governors being often different from that of the governed, and the rulers being also often liable to be called to account for the evils suffered by the people, sovereigns have had guards from the most ancient times. The Assyrian and Persian monarchs had body-guards, from whom the generals

of the troops were taken. Alexander formed a guard of nobles, and many such have existed in modern times. These guards of Alexander's were the sons of the noblest persons of the empire, and were divided into two classes. The inferior class guarded the exterior of the palace or tent, took care of the king's horses, &c. From among them were chosen the *hetœri*, or friends, who dined with the monarch, and in the field and at the chase never left his side. Two of their number watched his bedroom. He promoted them to be generals; and several of them, after his death, became monarchs of those countries which, during his life, they had ruled as his governors. Still more like modern guards were the *argyraspides* (the silver-shielded), commanded by Nicanor, son of Parmenio. The *prætorians* were the guards of the Roman emperors, and ultimately had the greatest influence on their election, sometimes the entire control of it. In their licentiousness and political importance they resembled the Janizaries, old guards of the sultans. As early as the tenth century the Byzantine emperors surrounded themselves by a guard of Varangians, Scandinavian adventurers, who first came through Russia, and were kept up by recruits from Denmark and England. At a later period the *trabants* and *hatschiers* (archers) guarded the persons of the German-Roman emperors; and similar troops were maintained at other courts. The guard of Clovis of France consisted of a small body of cavalry. About the middle of the fifteenth century Charles VII. selected for his body-guard a company of Scottish archers, who had distinguished themselves in the war in which the English were expelled from France. (See GARDE ÉCOSSAISE.) Louis XI. added two French companies, and Francis I. by the formation of a third raised the number of the body guard to 430 men. This was increased to 1600 by Louis XIV. In 1616 a Swiss company was added to the body-guard of the king. (See GARDES SUISSES.) Besides these guards, the French kings maintained a select body of troops, called the royal guard, which under Louis XIV. amounted to 10,000. In 1789, when the revolution began, all the branches of the guards amounted to 8155 men. They were disbanded during the revolution, were restored by Louis XVIII. in 1815, and in 1830 again disbanded. The Imperial Guard, formed by Napoleon I. in 1804, was among the finest troops that ever existed. It was formed from a small body of soldiers which had served to defend the Convention, the Corps Législatif of 1795, the Directory, and afterwards the Consulate. Its augmentation and equipment became one of the emperor's favourite pursuits. In 1809 he divided it into the old and the young guard. In 1812 the Imperial Guard, old and young, amounted to 56,000 men. They perished in thousands during the retreat from Moscow. They were re-organized at the close of this campaign on the same basis, but three years later were almost completely annihilated at Waterloo. The Imperial Guard was revived by Napoleon III. in 1854, and took part in the Crimean war in 1855, and in the Italian campaign of 1859. It was placed under the command of Bazaine in the Franco-German war of 1870–71, and its career was ingloriously closed at Metz, where a whole French army gave themselves up as prisoners of war.—In Russia the czar, Ivan Vasilievitch, formed, in the latter half of the sixteenth century, a body of guards termed *strieletzi* (archers), whose numbers rose sometimes to 40,000. They became formidable to the government, and were finally suppressed by Peter the Great, who put thousands of them to death and banished the rest to Astrakhan, where, in consequence of their turbulence, they were entirely destroyed in 1705. An imperial guard was formed by succeeding czars, which in 1785 amounted to 10,000, and now forms a complete army corps exceeding 50,000 in number. Frederick the Great of Prussia had several battalions of infantry and several squadrons of cavalry as guards; they were troops of distinguished courage and remarkable height. The German guard now forms a complete army corps, and one of the finest and best appointed bodies of troops in Europe. The Austrian emperor has a body-guard of nobles numbering about 600, but there is not in the Austrian army a select corps corresponding to the imperial guards of Germany or Russia. In England the guards, otherwise called the household troops, consist of three cavalry regiments —the 1st and 2nd Life Guards, and the Royal Horse Guards (the Blues); and four infantry regiments, namely, the Grenadier Guards, the Coldstream Guards, the Scots Guards, and the Irish Guards. The 1st and 2nd Life Guards, and the Royal Horse Guards, stand at the head of the cavalry of the country as the four regiments of foot guards do of the infantry. There are also seven regiments of 'Dragoon Guards', but they are cavalry of the line. The first English body-guards were embodied in 1485, the horse guards in 1550, and the foot guards in 1660. The British guards number about 9300 officers and men. They constitute the garrison of London and the guard of the sovereign at Windsor. When commissions were purchased, the 'regulation' prices—which of course were often exceeded—were much higher for commissions in the guards than in the line regiments. Thus a lieutenant-colonel's commission in the life guards and horse guards cost at least £7250; in the foot guards, £4800; in the line, £4500; a major's in the life and horse guards cost £5350; in the line, £3200.

GUARD-SHIP, a vessel of war appointed to superintend the marine affairs in a harbour, and to visit the ships of war which are not commissioned every night; she also acts as a depôt for seamen raised in the port for the navy until appropriated to other vessels. The name is also given to ships of the British navy stationed at different ports, and serving as the head-quarters for the different coast-guard districts. These vessels are kept without their full complement of men, it being understood that a full crew can be made up from the men of the coast-guard, when this becomes necessary.

GUARINI, GIOVANNI BATTISTA, born at Ferrara, 1537, was descended from a noble family, distinguished for its influence on the revival of learning and of poetry. After having studied at Ferrara, Pisa, and Padua, and lectured in his native city on the ethics of Aristotle, he entered the service of duke Alphonso II., who appreciated his talents, knighted him, and sent him as his ambassador to the Venetian republic, to Emanuel Filibert, duke of Savoy, to Gregory XIII., Maximilian II., and Henry of Valois, who was chosen King of Poland; and when the latter ascended the throne of France under the name of Henry III., Guarini was sent to the Polish estates to propose the duke as a candidate for the throne of Poland. The failure of this embassy, which involved the sacrifice of a part of Guarini's own property, was taken advantage of by his jealous rivals to deprive him of the favour of his prince; and after all his services he was dismissed. He now passed his time in literary retirement, partly in Padua and partly on his own estate, but was recalled in 1585 to the office of secretary of state. He again attained a distinguished rank in the court, but two years after retired a second time, because the duke, in a dispute between Guarini and his daughter-in-law, gave a decision which displeased him. He then continued some time in private life. In 1597 he entered the service of Ferdinand I., grand-duke of Tuscany, which he soon quitted. Sub-

pecting that the duke had favoured the marriage of his youngest son, which had been concluded privately against Guarini's will, he left his court and retired to that of the Duke of Urbino. After some time he returned to Ferrara, but resided alternately at Venice, Padua, and Rome, on account of the numerous lawsuits in which his litigious spirit involved him. In 1605 he went as an ambassador of his native city to the court of Rome, to congratulate Paul V. on his elevation. He died at Venice in 1612. Guarini is one of the most elegant authors and poets of Italy, as is shown by his letters, his Segretario, a dialogue, his comedy, La Idropica, his Rime, and above all by his Pastor Fido. This pastoral drama, which was first represented at Turin, on the marriage of Charles Emanuel, duke of Savoy, with Catharine of Austria (1585), and afterwards frequently brought upon the stage, and translated into many languages, has rendered him immortal. Guarini's works appeared at Ferrara in 1737 (four vols. 4to). His Tratato della Politica Libertà (written about 1599) was first printed at Venice in 1818, with his life by Ruggieri.

GUASTALLA, a town of Italy, in the province of Reggio nell' Emilia, at the confluence of the Crostolo with the Po, 24 miles north-west of Parma. The district is marshy, but fertile, and is intersected by several canals. The town is the seat of a bishop, and many of its inhabitants are engaged in the cultivation of rice. Guastalla was formerly the capital of a small duchy of the same name, which at one time belonged to the dukes of Mantua. The line becoming extinct in 1746 it was given to Parma, and in 1795 was comprised, with all the dominions of this house, in the Italian Republic. In 1815 it was annexed to the duchy of Parma, and given to Maria Louisa, wife of Napoleon, as Duchess of Parma, at whose death, in 1847, it passed to the Duke of Modena, and along with his other estates was annexed to Sardinia in 1859.

GUATEMALA, or GUATIMALA, an independent republican state of Central America, having the Mexican province of Campeche on the north, those of Tabasco and Chiapas on the north-west and west, the Pacific on the south-west, and the states of San Salvador and Honduras, the Bay of Honduras, and the territory of British Honduras or Belize on the east. The area is estimated at 63,400 square miles, and the population in 1900 at 1,574,000. It is administratively divided into 22 departments. The capital is New Guatemala.

The country is in general exceedingly picturesque and beautiful; and, like the other states of Central America, it is distinguished by a luxuriant and varied vegetation. 'The change of scene on entering the state of Guatemala', says Mr. Dunlop, 'is very remarkable; indeed, it is a singular circumstance that nature, not man, appears to have separated the different states of Central America, each of which is entirely of a different geological and physical character from the rest; and the change from the green undulating hills of San Salvador to the wild precipitous mountains and rocks of Guatemala is most striking.' Guatemala is wholly mountainous, the main chain of the continuation of the Mexican Sierra Madre traversing it north-west to south-east, at no great distance from the Pacific, and sending off numerous branches towards the Atlantic, thus forming a great many valleys, but inclosing few plains. Along the main chain are a considerable number of volcanoes. All of them are near the Pacific, and none of them are found in the interior. Some are active—namely, Atitlan, 12,500 feet; Tajamulco; Quemado; and Fuego, 13,100. The state is well watered by numerous streams, of which the Usumacinta, forming part of the Mexican boundary, and flowing into the Bay of Campeachy, the Motagua, and the Polachic continued by the Dulce, both flowing north-east to the Bay of Honduras, with their tributaries, are the largest; and there are many streams of comparatively short courses falling into the Pacific. There are, likewise, several lakes, the most important being Dulce; Amatitlan; Atitlan; and Peten, near the frontiers of Campeche, 30 miles long by 9 miles broad. The chief ports are San José, Champerico, and Ocos on the Pacific, and Livingstone on the Atlantic. On the table-land, of which a considerable portion of the state is formed, the climate is mild, and said greatly to resemble that of Valencia in Spain; but in more elevated situations the cold is intense. The soil generally is of great fertility, producing maize and wheat of superior quality, excellent rice, legumes, and vegetables and tropical fruits in great variety. But the want of enterprise in the people, and the absence of good roads through the country, are great drawbacks to agriculture. The first railway, 13 miles long, from San José to Esquintla, was opened in 1880, and there are now over 130 miles open. The most important product is coffee, the cultivation of which has of late years become very extensive, the total quantity sent abroad in 1897 being valued at £3,770,000. The other chief exports of Guatemala are bananas, skins, caoutchouc, cochineal, wool, &c. The trade is chiefly carried on with Great Britain and the United States. Cacao, tobacco, bananas, sugar, vanilla, and cotton are grown to a greater or less extent; and also considerable quantities of indigo. In the northern parts of the state considerable flocks of sheep are raised, the wool of which is manufactured by the natives into a coarse fabric, which again is made into various articles of clothing, including large plaids, called *ponchos*, in which considerable taste is displayed. About three-fifths of the population are Indians, the remainder being mostly half-caste. Whites of Spanish or other origin are comparatively few. Property is secure and the roads safe, and foreigners enjoy exceptional privileges.

Guatemala was conquered by the Spaniards in 1524. It achieved independence in 1821, afterwards formed part of the Confederation of Central America, but became an independent republic in 1839. It is governed under a constitution proclaimed 2nd October, 1879, and subsequently modified. By its terms the legislative power is vested in a National Assembly elected for four years by universal suffrage. The executive is vested in a president, elected for six years, and assisted by a cabinet. Roman Catholicism is the prevailing religion, but there is no established church, and all creeds have perfect freedom of worship. Primary education is free and compulsory, the primary schools having over 75,000 on the roll. The effective army comprises about 57,000 men, with a reserve of 30,000. The standing army numbers about 7000 officers and men.

GUATEMALA, OLD, a city of Central America, the former capital of the state of Guatemala, 10 miles south-west of New Guatemala (see next article), close by the Volcano de Fuego and the Volcano de Agua, in a valley open to the south-west, but on all other sides inclosed by high mountains. It was founded by the Spanish conquerors in 1542, after the destruction of the first capital by water from the Volcano de Agua, and continued to be the capital of the country till 1773, when it was nearly wholly destroyed by an earthquake, being left, with the exception of a few of the more substantial edifices, little better than a pile of rubbish.

A new town arose here, which also was destroyed by an earthquake in 1874, but is again rising.

GUATEMALA, SANTIAGO DE, or NEW GUATEMALA, a city in Central America, capital of the state of same name, finely situated at the extremity of a plain 20 miles long by 6 miles broad, with a deep ravine on three sides. It lies 4850 feet above the sea, and has wide streets crossing each other at right angles. The houses being only one story high, on account of the frequent earthquakes, and furnished with small grated windows, have a mean appearance. Among the public buildings the principal are the cathedral, the archbishop's palace, the palace of the legislature, the University of San Carlos, the Tridentine College, numerous churches, the Hospital of San Juan, the theatre, &c. The city communicates by railway with San José on the Pacific, and carries on a large trade. Its manufactures include textile goods, saddlery, goldsmiths' wares, &c. Tramways, telephones, and the electric light have been introduced. New Guatemala was founded in 1776. (See above.) Pop. (1893), 71,000.

GUAVA (*Psidium*), a genus of plants belonging to the natural order Myrtaceæ, and containing nearly forty species, natives of the intertropical parts of America, with one or two exceptions. They are trees or shrubs, with opposite entire leaves, and axillary white flowers. The *P. pyriferum* attains the height of 18 or 20 feet, and is now cultivated in all the intertropical parts of the globe for the sake of its fruit, which has a sweet, agreeable flavour, and is considered very wholesome. The leaves are oval-acute, and the fruit shaped like a pear, and about as large as a pullet's egg, yellow without, with a fleshy pulp, and is either eaten raw or made into jelly. The wood, which is very hard, is much used for various mechanical purposes, as also for burning, and makes excellent charcoal. One species has been cultivated with complete success in the south of France.

GUAYAQUIL, the principal seaport of the Republic of Ecuador, in the province of Guayas, is situated on the river Guayaquil, about 25 miles above where it enters the Gulf of Guayaquil. The site is low and level, and the climate is hot, moist, and unhealthy, yellow fever being not uncommon; but draining operations and the provision of a good water-supply have considerably improved its sanitary conditions. The town is intersected by several streams, and is divided into the old town in the north and the new town in the south. The streets are in general straight and regular; they have been recently much improved by paving, and tramways have been introduced, as well as gas and telephones. The houses are mostly built of timber or bamboo and mud. Among the chief buildings are the cathedral and other churches, the town-house, a college, a technical school, hospitals, banks, &c. Large sea-going vessels can come up to the town, and the trade carried on is very considerable. A railway runs into the interior of Ecuador from Guayaquil, and the river, and its tributary the Daule, are navigable for smaller vessels a considerable distance above the town. The chief foreign exports are cacao, coffee, ivory-nuts, india-rubber, straw-hats, hides, and bark. Cottons, hardware, and other manufactured articles are imported. The town contains saw-mills, woollen and cotton mills, and a brewery, and there are works for the manufacture of soap, chocolate, biscuits, and vermicelli. The town was largely destroyed by fire in 1896 and 1899. Pop. 50,000.

GUAYAQUIL, GULF OF, a gulf of the Pacific, in the Republic of Ecuador, having a wide entrance, narrowing as it extends inland, and receiving at its head the Guayaquil River. The gulf is diversified by numerous islands.

GUAYAQUILLITE, a fossil resin found at Guayaquil, in South America, but a body analogous to it, if not identical with it, has been met with in the coal at Airdrie, in Scotland.

GUAYMAS, a seaport of Mexico, in the state of Sonora, on the Gulf of California, the terminus of a railway connecting it with the United States railways. It exports gold, silver, hides, &c. Pop. 7000.

GUAYRA, LA, a seaport in Venezuela, on the Caribbean Sea, closely surrounded by mountains and precipices, being situated on the narrow strip of land between the coast range and the sea, about 10 miles north of Caracas. It is connected by railway with Caracas, and carries on a considerable trade, exporting coffee, cacao, skins, and hides, and importing manufactured goods, provisions, wines, &c. It had till recently only an open roadstead, but a breakwater and other works have now been constructed. The harbour works and the La Guayra and Caracas railway are British enterprises. The climate is unhealthy. Pop. 14,000.

GUBBIO (ancient *Iguvium*), a town of Italy, in the province of Perugia, 18 miles N.N.E. of the town of Perugia. It is a bishop's see, and has manufactures of silk and woollen stuffs. The chief edifices are the 14th-century Palazzo dei Consoli, the 12th-century cathedral, and the Palazzo dei Duchi. Gubbio was formerly celebrated for the manufacture of majolica-ware. Here were discovered the Eugubine Tables (which see) in 1444. Pop. 5540.

GUBEN, a town of Prussia, in the province of Brandenburg, at the confluence of the Lubis with the Neisse, 27 miles S.S.E. of Frankfort-on-the-Oder. Brewing, dyeing, and tanning are carried on here, and there are manufactures of woollen and linen cloth, felt hats, leather, iron, and earthenware, and a trade in wool, wine, fruit, and cattle. It was taken by the Czechs in 1434 and 1437, in 1620 by the Saxons, and in 1631 and 1632 by the Swedes. Pop. in 1895, 31,182; in 1900, 33,122.

GUDGEON (*Gobio*), a genus of fishes of the carp family, having the dorsal and anal fins short, without spines, and in the English species at least with an equal number of rays. At the angle on each side of the mouth there is a small barbel of ¼ inch in length. Neither jaw is furnished with teeth, but at the entrance of the throat there are two triangular bones that perform the office of grinders. The air-bladder is double, the second posterior sac tapering backwards. These fish are easily taken, and are generally of small size, measuring only about 6 inches. They are good eating. The common gudgeon (*G. fluviatilis*) is brownish and black above, and white below. Its length is about 6 or 7 inches.

GUEBERS, GUEBRES, the so-called fire-worshippers of Persia, in India called *Parsees*, that is, Persians. They call themselves *Behdin*, or followers of the true faith, or *Mazdaasnan*, that is, worshippers of Ahuramazda or Ormuzd, their religion being that established by Zoroaster (which see). These people may generally be described as laborious and temperate cultivators of the ground. Their manners are mild. They drink wine, eat all kinds of meat, marry but one wife, and live chastely and temperately. Divorce and polygamy are prohibited by their religion; but if a wife remains barren during the first nine years of marriage the husband may take a second wife. They worship one Supreme Being, Ormuzd, the principle of light and the source of all that is good; but they believe in the existence of another spirit contending with Ormuzd, namely, Ahriman, the principle of darkness and the source of evil. The sun, moon, and planets they believe to be peopled with rational beings. They are commonly spoken of as worshippers of fire; but they them-

selves say that they do not worship fire, but only find in it an image of the incomprehensible God, on which account they offer up their prayers before a fire, and maintain one uninterruptedly burning on holy places, which their prophet Zoroaster, they say, kindled 4000 years ago. Their altars (*Atesh-Gah*) consist of lofty columns, which symbolize flame. Their holy book is called *Zend-Avesta*. One of the peculiarities of the Guebers is that they do not bury their dead, but expose the bodies upon the towers of their temples to be devoured by birds. They observe which parts the birds first eat, from which they judge of the fate of the deceased.

The Guebers are now widely distributed throughout the district of Yezd in Persia. Abbas the Great of Persia, who reigned at the end of the sixteenth and beginning of the seventeenth century, wishing to encourage the development of industry in his capital, Ispahan, brought about 1500 families of the Guebers and settled them in a separate quarter of the town. Here they lived undisturbed till the reign of Abbas II., about the middle of the seventeenth century, when a persecution began, intended to root out the faith of the fire-worshippers. Many of them fled to the mountainous districts from which they had been drawn; some removed to the northern region of Mesopotamia in the Turkish Empire, where they settled among their co-religionists, who had been subdued by the Turks, and nominally converted to Mohammedanism; others sought a refuge in India. Those who still remained at Ispahan were transferred from the quarter that they had previously occupied to the Armenian colony at Djulfa, a southern suburb of Ispahan. When the persecution still continued numbers more fled chiefly to the province of Khorasan. In course of time the practice of their religion was suppressed and their altars destroyed throughout the whole empire of the Sassanides. The last altar that was allowed to stand is said to have been at Herat, where the Guebers paid a tax for permission to maintain it. In the eighteenth century there were scarcely 300 families of Guebers at Djulfa, and the whole number in Persia is now said to be not more than 8000.

The Guebers who had sought a refuge in India met with a better fate than those who remained in their own country. A district in Guzerat was assigned them, where they lived unmolested on the condition of adopting some of the Indian customs. Here they prospered, and from this centre sent out in course of time various colonies to the neighbouring districts, including districts on the Indus, and in other parts of India, &c. Under British rule the Parsees have established themselves in most of the principal commercial towns on the coast of India, as Bombay, Surat, Baroda, Madras, as well as at Aden, Ormuz, on the east coast of Africa, and elsewhere. They are nearly all in easy circumstances, many of them wealthy bankers and merchants. They are very charitable, especially to those of their own faith.

Monuments of the ancient Guebers are to be found throughout the whole territory lying between the Caspian and the Indian Ocean on the one hand, and the Indus and Euphrates on the other. The ruins at Hamadan, supposed to be those of the ancient Ecbatana, are attributed to them, and in the province of Farsistan, the original seat of the Persians, the remains of ancient cities (Pasargadæ, supposed to be the modern Murghad, with the tomb of Cyrus; and Persepolis, now called Takhti Djemshid, the throne of Djemshid) are unquestionably monuments of this race. In the district of modern Persia called Azerbijan (anciently Media Atropatene) there are the remains of walls of very massive construction which are also supposed to have been built by them.

GUEBWILLER (the French form of *Gebweiler*), a town in Germany, in Upper Alsace, 13 miles S.S.W. Colmar, on the Lauch, at the foot of the round-topped mountain called the *ballon* of Guebwiller. It is well built, has two remarkable churches, one of which is of the eleventh century; manufactures of cloths, woollens, ribands, cottons, plain and printed; fine cotton yarn, sewing silk, chemicals, and machines; it has also bleacheries and a sugar refinery. Near it are coal mines and slate quarries. Pop. (1900), 13,259.

GUELDERLAND. See GELDERLAND.

GUELFIC ORDER, an order of knighthood instituted for the Kingdom of Hanover in 1815 by the Prince-regent of England and Hanover, afterwards George IV. of England, and conferred by the kings of Hanover until the absorption of that kingdom by Prussia in 1866. Its statutes were revised in 1841 and again in 1849. At the present time the knights of this order are divided into four classes—Knights Grand Cross, Commanders of the first class, Commanders of the second class, and Knights. The motto is, '*Nec aspera terrent.*'

GUELFS, the name of a distinguished princely family which originated in Italy, but in the eleventh century was transplanted to Germany, and which still flourishes in the two lines of the house of Brunswick, the royal (to which the reigning family in Britain belongs) and the ducal. The name is originally German, and in that language is spelled and pronounced Welf (whelp). Welf, the son of Isenbrand and grandson of Warin, count of Altorf, one of the vassals of Charlemagne, is said to have been the first who bore the name. The elder German line of this family expired with Welf III., who held in fief from the empire the Duchy of Carinthia and the Mark of Verona, but dying unmarried he left all his possessions to the church. His mother, Irmengard, however, induced Albert Azzo II., of the house of Este (died 1097), the husband of her daughter Kunigunde (Cunegonda), to send his son Welf to take possession of the Welf estates in Germany. This was done, and Welf became the founder of the younger line of this family in Germany, with the title of Welf I. To the estates previously belonging to the family Welf added, after the deposition of Otto of Nordheim, the Duchy of Bavaria, and after his father's death he inherited the estates of the Este family in Italy. He joined the first Crusade, and died on his return on the island of Cyprus in 1101. He was succeeded first by his son Welf II. (died 1120), and then by another son, Henry the Black, who acquired by his marriage with the daughter of Duke Magnus of Saxony a part of the Lüneburg estates. Henry the Black was succeeded in 1126 by Henry the Proud, who by his marriage with the daughter of the Emperor Lothaire acquired the right of succession to the hereditary domains of Brunswick, Nordheim, and Supplinburg. He also received from the emperor the Duchy of Saxony. His son Henry the Lion (1139–95) was reduced by the Emperor Frederick Barbarossa to the possession of Brunswick and Lüneburg. From him, through his son William (died 1213), and his grandson Otto (died 1252), sprang the royal and ducal houses of Brunswick. Another branch of the Guelf family was continued by Welf III., son of Henry the Black and brother of Henry the Proud, but on his death in 1169 he bequeathed his possessions to the emperor. See BRUNSWICK (FAMILY OF) and GUELFS AND GHIBELLINES.

GUELFS (or GUELPHS) AND GHIBELLINES, the names of two great political parties in Italy in the thirteenth and fourteenth centuries. The names are derived from the Italian *Guelfi* and *Ghibellini*, which are again corrupted from the German *Welfen* and

Waiblingen by the common change of an initial *W* into *Gu*. These words first came to be used as party designations in the war which broke out between Henry the Proud, of the family of the Welfs or Guelfs, and Conrad of Hohenstaufen, to whom belonged the estate of Waiblingen in the present Kingdom of Würtemberg. The occasion on which they were first used is said to have been the siege of Weinsberg in 1140, which took place after the death of Henry, the war being continued on behalf of his young son, also called Henry, afterwards known as Henry the Lion. The contest, which in the beginning was merely between the two families, spread at length more and more widely until it assumed the dimensions already indicated. The designations were introduced into Florence about the year 1200, and in Italy the name of Guelfs became the watchword of the party which aimed at national independence, and accordingly supported the popes who defended it, while that of Ghibellines became the watchword of the party who supported the emperors of the house of Hohenstaufen in their endeavours to subject Italy to Germany. The Guelfs thus appeared at the same time as the champions of the spiritual power, as represented by the popes, against those of the secular power, as represented by the emperors. The original distinction between the designations was lost about the end of the thirteenth century, after the fall of the Hohenstaufen, but the names nevertheless continued in vogue, the Ghibellines being henceforth the partisans of aristocracy, and the Guelfs the partisans of democracy and liberty. The names fell out of use about the middle of the fifteenth century. Italy underwent great sufferings during this contest, as did Germany also, which sent army after army to be swallowed up in this lion's cave, as a German emperor called it. There is little doubt that the inconsiderable progress of Germany in public law and political well-being during this period was in a great measure owing to this struggle, which consumed her strength and engrossed her attention. The contest continued with bitterness for almost 300 years. These parties appeared in Italy under many different names, as the *bianchi* and *neri* (white and black) in Florence, &c. History shows no instance of a more untiring and cruel party spirit.

GUERARA, a town in the Algerian Sahara, in the Oasis of Beni Mzab, about 40 miles E.N.E. of Gardaia. It is surrounded by a very high wall, and entered by three gates. The gardens are remarkable for their extent and fertility. All the tribes of the desert frequent this place either to buy or sell horses, asses, sheep, ivory, gold-dust, ostrich feathers, cotton, silk, cutlery, &c., brought chiefly from Tunis and Algiers. Pop. 4000.

GUERCINO DA CENTO, an Italian painter, born at Cento, in the Duchy of Ferrara, in 1590; died at Bologna in 1666. His proper name was GIOVANNI FRANCESCO BARBIERI, and he was called Guercino from a squint in his eyes. He studied at first under Cremonini and Benedetto Gennari; but latterly in the school of the Caraccis, at Bologna. In 1621, having already acquired renown as a painter, he was invited by Pope Gregory XV. to Rome, but the premature death of this pontiff induced him to return to his native town two years after. About 1642 he went to Bologna, where Count Aldovrandi received him in his palace and entertained him with the most magnificent hospitality. Guercino adopted three different manners of painting, the first in imitation of Caravaggio, which being very dark, he quitted for that of the Caraccis, and latterly for a style still more light and sketchy; but his middle style is his best. His chief pictures are at Rome. The most celebrated is that of the Martyrdom of Saint Petronilla, which has been copied in mosaic to adorn one of the panels in Saint Peter's, between the Transfiguration by Raphael, and the Communion of St. Jerome, by Domenichino. His other chief pictures include a St. Anthony at Padua; an Annunciation at Milan; St. Peter at Modena; Cephalus and Procris, and a scene from the Pastor Fido in the Dresden gallery; the Parting of Priam and Hector at Marseilles. The galleries of Bologna, Florence, and Paris, besides some of those of England and Germany, also possess specimens of this master. During his lifetime he enjoyed a very high reputation, and amassed a large fortune, which he employed in assisting his parents and friends, in giving his nephews and nieces a good education, and settling the former in the church, and the latter advantageously in marriage. He was extremely pious, and built several chapels and oratories.

GUERICKE, OTTO VON, was one of the most distinguished experimental philosophers of the seventeenth century. He was born at Magdeburg in 1602; studied law at Leipzig, Helmstedt, and Jena; mathematics, and particularly geometry and mechanics, at Leyden; travelled in France and England; acted as chief engineer at Erfurt; became, in 1627, counsellor at Magdeburg; and in 1646 burgomaster there, and counsellor of the Elector of Brandenburg, but resigned his office five years before his death, and repaired to his sons at Hamburg, where he died May 11, 1686. About 1650 he invented the air-pump, about the time that a similar idea occurred to Robert Boyle in England. This discovery gave rise to a more intimate acquaintance with the nature and effects of air. In 1651 he made the first public experiments with his machine, at the diet at Ratisbon, before the Emperor Ferdinand III. The first air-pump, with which Guericke almost exhausted the air from two hemispheres, is preserved in the royal library at Berlin. Guericke also invented an air-balance, and the small glass figures which were used before the invention of the barometer, to show the variations of temperature. The pressure of the atmosphere he exhibited by means of two large hollow hemispheres of copper and brass, an ell in diameter. These being fitted closely together, the air contained in the hollow sphere thus formed was exhausted by means of an air-pump. Guericke then harnessed horses to strong rings, attached to the hemispheres, and they attempted in vain to separate them. The number of horses was increased to thirty without success. An additional number at length made them part with a loud report. He was also an astronomer. His opinion that the return of comets might be calculated, has been confirmed. His most important observations, collected by himself, appeared at Amsterdam in folio (in 1672), entitled Experimenta nova, ut vocant Magdeburgica, de vacuo Spatio, &c. See AIR-PUMP.

GUERNSEY, the second largest and most western of the Channel Islands, lying off the north coast of France, from which it is about 28 miles distant, and from England about 68 miles. It is of a triangular form, about 9 miles long, and 3 to 6 miles broad. The northern part of the island is level, the southern more elevated, and intersected by numerous deep and narrow valleys; coast lofty and abrupt, some of the cliffs attaining a height of 270 feet. The island is almost entirely of granitic formation; the rocks are chiefly gneiss, granite, and syenite. The climate is extremely healthy; snow is rare, and frosts light and of short continuance; mean winter temperature, about 43° 5′; that of summer, 58° 6′. During the spring, east winds prevail, and west during the rest of the year. The soil is fertile, and owing to the minute subdivision of property, almost every farmer is the proprietor of the land he cultivates. In former years dairy-farming and the cultivation of

orchards and gardens formed, together with fishing, the leading occupations of the people. The magnificent climate and the long hours of sunshine favoured the production of vegetables and fruit, Guernsey pears being unrivalled. But recently the attention of the inhabitants has been directed to the cultivation of produce under glass, and so profitable has this proved that all other industries are now regarded as of secondary importance. Numberless greenhouses, some of immense size, have been erected in every part of the island, and are classified as 'hot' or 'cold', some being warmed by artificial heat and others solely by the sunshine. In these greenhouses crops of grapes, tomatoes, or early vegetables are raised and despatched to Covent Garden, and to various provincial markets. In the summer months the number of packages of tomatoes despatched to England in one day often exceeds 10,000. The 'growing' industry attracts every section of the community, fishermen, tradesmen, builders, and professional men being generally 'growers'; while English settlers engaged in the same occupation are yearly becoming more numerous. The breeding of cattle, once the principal object of attention, is still considered of importance in the island. The Guernsey breed of cows is very highly prized. Most of the orchards have been cut down to make room for greenhouses, and bush and tree fruit is largely imported from England. Owing to the mildness of the climate, flowers and shrubs flourish luxuriantly, geraniums and English greenhouse plants growing here in the open air throughout the year, while camellias blossom in the gardens in mid-winter. Granite is shipped in large quantities, chiefly from St. Sampson's harbour.

The constitution of the island is peculiar. Subject to the veto of the crown, it is self-governing; the legislative body, since the Reform of 1900, consisting of twelve jurats (who also have judicial functions) ten rectors, two crown-officers, delegates from each 'douzaine' or parish council, and deputies elected by the tax-payers. Residents of less than three years' standing pay no taxes. Guernsey has its own system of laws, of weights and measures, and of currency, an English sovereign being equivalent to £1, 1*s.* 0*d.* Guernsey money. The dialect of the island is old Norman, but English is everywhere understood, and, together with French, is taught in all parish schools. The capital of the island is St. Peter Port. The natives of Guernsey are a thrifty people. Owing to the great development of trade, and to the influx of English settlers in recent years, great reforms have been effected in sanitation, education, and government. The 'States of Assembly', or parliament, is presided over by the 'Bailiff', who is also president of the 'Royal Court', while the crown is represented by a lieutenant-governor. Pop. in 1881, 32,659; in 1891, 35,289; in 1901, 40,477. See CHANNEL ISLANDS.

GUERRERO, a state in Southern Mexico, on the Pacific, formed in 1849, and named after Guerrero, a former president; area, 24,996 square miles. It belongs to the lower and gradually descending portion of the great Mexican plateau, and has a surface finely diversified by mountain and valley, and partly covered by native forests. The productions are many and valuable, but agriculture is in a very imperfect condition, and the only tract which can be considered densely peopled is that which lies along the road leading from Acapulco to Mexico. The state is rich in gold, silver, copper, and iron-ore. Salt is obtained from the coast lagoons. The trade is unimportant. The capital is Chilpancingo. The principal port is Acapulco, with one of the finest harbours in the world. Pop. (1900), 474,594, mostly Indians.

GUERRILLAS (Spanish diminutive of *guerra*, war), in the war for Spanish independence, was the name of the light, irregular troops, who did much injury to the enemy, while their disconnected character and active movements secured them from suffering much in return. They consisted chiefly of peasants, who, in the ardour of patriotic zeal and religious fanaticism, having put to death such Frenchmen as fell into their hands on the first retreat of the French forces, fled to the mountains, on their return, to avoid their resentment, collected in numbers, chose leaders, and carried on a partisan warfare, without being paid or dressed in uniform. The general Juan Martin Diaz, surnamed *El Empecinado*, first organized them with some system in the vicinity of Madrid, after Saragossa had been taken by the French (1808), and Spain, by the defeat of its armies, seemed lost beyond recovery. Romana, however, extended the plan much further. They contributed to sustain the confidence of the people in the final success of their arms, and to maintain a spirit of determined resistance. It was a no less important circumstance that every advantage gained by the Spanish and British troops was speedily proclaimed, by their means, in all quarters. Similar bodies have taken an active part in the Carlist wars of Spain, and the term is now used in a general sense.

GUESCLIN, BERTRAND DU. See DU GUESCLIN.

GUEUX, or GEUSEN (*Beggars*). This title was, in the time of Philip II., assumed by the allied noblemen and other malcontents in the Netherlands. In 1564 Philip sent nine inquisitors there, to execute the decrees of the Council of Trent, thus causing great excitement among Protestants and Catholics. The nobles, Count Louis of Nassau and Henry of Brederode, bound themselves by a compact, called the *compromise*, not to appear before the nine inquisitors, and in solemn procession made known their resolution, in April, 1566, to Margaret, duchess of Parma, then at the head of the government. The princess, during the audience, happening to show some embarrassment, the Count de Berlaymont, president of the council of finance, whispered to her that she ought not to manifest any fear of such a mob of beggars (*tas de gueux*). Some of the confederates overheard this, and on the evening of the same day communicated it at a meeting of their members, who immediately drank to the success of the *gueux*, and agreed thereafter to be called by that name. They adopted as a token a coin bearing on one side the head of Philip, king of Spain, with the inscription '*En tout fidèles au roi*' (In all things faithful to the king), and on the other side a wallet, such as is worn by begging friars), with the inscription '*Jusqu'à porter la besace*' (Even to carrying the beggar's wallet). The capture of Brill in 1572 by a section of them known as the Beggars of the Sea was the first great success gained by the Netherlanders in their struggle with Spain, and ultimately led to the triumph of their cause.

GUEVARA Y DUEÑAS, LUIS VELEZ DE, a Spanish dramatic poet, was born at Ecija in Andalusia in 1574. He applied himself to the study of the law, and practised in Madrid, where, in the exercise of his profession, he became noted for his inexhaustible fund of humour, and obtained the acquaintance of the king (Philip IV.). The monarch, who knew his talent for poetry, induced him to write comedies, with which he obtained no small success. The literary fame of Guevara, however, rests chiefly on his Diablo Cojuelo (Lame Devil), o Memorial de la otra Vida, a romance, in which he describes with great humour and spirit, and lashes with inimitable satire, the manners of his countrymen and life in

Madrid. It suggested the famous Diable Boiteux of Le Sage. Guevara died at Madrid in 1646.

GUGLIELMI, PIETRO, was born in 1727, at Massa Carrara, where his father, Giacomo Guglielmi, was chapel-master of the Duke of Modena. He studied music with his father until his eighteenth year, and afterwards went to Naples to the conservatory of Loretto, then under the direction of the celebrated Durante. He left the institution in his twenty-eighth year, and immediately began to compose comic and heroic operas for the Italian theatre, in both of which he was equally successful. He visited Vienna, Madrid, and London, and afterwards returned to Naples, where he made a most brilliant display of his talents in a professional rivalry with Paesiello. To every work of his adversary he opposed another, and was always victorious. In 1793 Pius VI. named him chapel-master of St. Peter's, which gave him an opportunity of distinguishing himself in sacred music. He has left more than 200 pieces, remarkable for their simple and beautiful airs, for their clear and rich harmony, and for their spirit and originality. He died in 1804.

GUIANA, BRITISH, a colony in the north of South America, about 560 miles long, S.E. to N.W., and about 200 miles broad, having E. Dutch Guiana, W. Venezuela and Brazil, N. and N.E. the Atlantic, and S. Brazil. Estimated area, 120,000 sq. miles. The western boundary was fixed by arbitration in 1899, the British claims being on the whole justified. Its coast-line, including indentations, is nearly 500 miles long, extending from the river Corentyn to Point Playa, about lon. 60° W. It is divided into three counties—namely, Berbice, the most easterly of the three, Demerara, and Essequibo. The whole surface of the coast lands is on a level with the high-water of the sea. When drained, banked, and cultivated, they consolidate and sink fully a foot below it; in consequence of which it becomes necessary to pay unremitting attention to the dams and sluices, to keep out the sea, otherwise great destruction and damage to the land ensues. Shallows, or muddy banks, stretch along the whole line of coast, and run several miles into the sea; they are in some parts dry, in others covered with not more than from 3 to 4 feet water. The entire absence of all landmarks on these flat and monotonous shores renders it difficult for strange vessels to ascertain at what particular point of the coast they are. The level country extends from 10 to 40 miles inland, when it is arrested by a range of sand-hills of low elevation, the highest not exceeding 200 feet. Behind these hills the high land stretches out in level or undulating plains, rising here and there into eminences. Notwithstanding the general flatness of the country towards the coast, the interior is traversed, in various directions, by chains of mountains; few of them, however, of any great height. Of these mountains, the Pacaraima range, which enters the colony from the west, is the most remarkable, and exhibits the loftiest elevations—the culminating point, *Roraima* (in Venezuela), rising to a height of 7800 feet above sea-level. The other principal ranges are the Sierra Imataca, in the north part of the country; the Cannucu or Conocou, and the Sierra Acarai—the last occupying the extreme S.E. corner of the territory, forming its boundary in this direction. They are densely wooded, but do not reach a greater elevation than 1000 feet. The geological composition of the mountains of British Guiana is various. Some of them consist of granite, gneiss, and trap rocks, and their different modifications; others are of sandstone; and others, again, appear to be of white quartz. Gold occurs in various places, and is now obtained in increasing quantities. Rock-crystals and red agate are met with; and very pure white clay is found in the Essequibo. The extensive flats along the shore are composed of alluvial soil and clays, resting upon granite. These alluvial flats are, in many instances, covered with a black vegetable matter, the detritus of numerous rivers. The principal rivers are—the Essequibo, Demerara, Berbice, and the Corentyn, the last forming the boundary between British and Dutch Guiana.

Climate.—Guiana has two dry and two wet seasons, each continuing for three months: the wet embrace the months of December, January, and February—and then June, July, and August; the dry the other months. The mean annual temperature is about 81°. Violent thunder-storms occur at the change of the seasons; but hurricanes, so destructive in the West Indies, are unknown. In the dry seasons the climate is agreeable, and in the interior more healthy than in many parts of the West Indies.

Soil, Agriculture, Vegetable Products, &c.—The soil is, in general, very fertile; and that of Demerara, in particular, well adapted for the cultivation of the sugar-cane, which is the staple industry of the colony. The cultivation of the cane is carried on chiefly by numbers of coolie labourers brought from India. (See COOLIE.) Some cacao, coffee, rice, tobacco, indigo, ginger, &c., are also grown. Cotton was also cultivated formerly to a considerable extent, but is now nearly extinct, on account of the scarceness of labour. Vegetation is singularly vigorous and luxuriant; the forest-trees, which cover about one-half the surface, are of the most magnificent description; especially the mira-tree (*Mimosa excelsa*), described as attaining the height of 130 to 150 feet, and as appearing at a distance, from its immense size, like a hillock clothed with vegetation. The timber of this tree is said to be equal to the teak of the East Indies. Fruit-trees of various kinds also abound. Amongst the indigenous fruits are—the pine-apple, guava, the marmalade fruit, the anona, the sapodilla, and the Brazil and suwarrow nuts. The cabbage-tree is common, and there are several varieties of palms. Medicinal plants also abound, including quassia, a species of ipecacuanha, gentian, and many others. There are many fibrous vegetables which afford substitutes for hemp and flax; and in the forests dyeing woods, cochineal, gum-copal, and a multitude of other valuable vegetable productions, abound. The flora is rich and varied, and includes the *Victoria Regia*, the largest of the water-lilies, whose immense bright green leaves, and enormous white and pink flowers, are to be seen floating on some of the rivers.

Zoology.—The animals are those of tropical South America generally—the jaguar, tapir, armadillo, agouti, ant-bear, sloth, deer, a great variety of monkeys, iguanas, large alligators, and turtles; several kinds of parrots, macaws, and humming-birds; the flamingo, Muscovy duck, toucan, and spoonbill. In the forests the vampire bat abounds. Snakes are numerous, and many of them poisonous; and troublesome insects are almost intolerably plentiful, as might be expected from the swampy nature of the coast districts. The rivers abound with a great variety of kinds of fish, many of them highly prized for the table; they include the silurus, which often measures 12 feet in length, and weighs upwards of 2 cwts. The domestic animals are—horses, mules, hogs, goats, and fowls. Black-cattle and horses are reared on the savannas, but are little attended to.

Commerce and Shipping.—The trade of the colony is concentrated mainly in George Town. Sugar, rum, molasses, and gold form the principal exports. The exports for 1889 amounted to £2,471,200, the imports to £1,803,776; the exports in 1899-1900 were £1,927,960 (£1,101,254 of this being sugar, £416,630 gold); the imports, £1,318,701.

Government, &c.—According to the constitution, as amended in 1890, the colony is administered under a governor, an executive council, a 'court of policy', and a 'combined court'. The court of policy consists of the governor, seven official members, and eight elected members, and its functions are legislative. The court of policy, with six elected financial members added to it, forms the combined court, which has the power of imposing taxes and discussing the annual estimates. To be elected a member of the court of policy, a person must be possessed of real property to the value of £1562, 10*s.*, or of a house, or house and land, to the annual value of £250. A similar qualification is required for a financial representative, or £300 a year from a profession or trade. The Roman Dutch law is generally in force in civil cases; the criminal law is based on that of Britain. The revenue of the colony for 1899–1900 was £538,838; the expenditure, £525,542. The public debt only amounts to £975,791. There are a considerable number of schools aided by government, in addition to which others have been established by the proprietors or managers on several of the estates for the education of Indian immigrant children. There is a government high school at Georgetown, the capital.

History.—Guiana is said to have been first visited by the Spaniards about 1499 or 1500. The first settlement, to which the name of New Zeeland was given, was formed by the Dutch about 1580, on the River Pomeroon, whence they spread east to the Essequibo and Demerara. In 1781 the colony was taken by Sir George Rodney; but it was restored to the Dutch in 1783. In 1796 it surrendered to the British, and was again restored to the Dutch by the Peace of Amiens in 1802. It was again taken by the British on the breaking out of the war in 1803, and by a treaty concluded at London, August 13, 1814, and confirmed August 12, 1815, it was definitively given up to them. In 1831 the three separate colonies of Berbice, Essequibo, and Demerara were united under the name which the colony still bears. Pop. in 1898, 278,328 (including blacks, 99,615; East Indians, mainly coolies, 105,465; Chinese, 3714; persons born in Europe, 2533).

GUIANA, Dutch, or Surinam, a Dutch colony in South America, situated between English and French Guiana, having the former on the west and the latter on the east. Its coast-line extends from the river Corentyn to the river Maroni. The length of the territory, north to south, is 300 miles, and the average breadth about 230 miles; area, about 46,000 square miles. The general aspect of the country is the same with that of British Guiana above described—flat and swampy on the coast, and mountainous in the interior; well-watered by numerous streams, flowing generally south to north; and of which the Surinam and its affluents, and the Saramacca with its affluents, and the Coppename, are the chief. It has also a similarly warm, moist climate, and is very fertile. Only a small part of the colony has been brought under cultivation as yet, the settled portions being chiefly confined to the lower course of the river Surinam and the coast, while the remainder is still mostly covered with the primeval forest. The cultivated districts are intersected by numerous canals, and so much labour is bestowed on the soil by the husbandman that parts resemble an extensive garden, and yield similar products. On the right bank of the Surinam river, and about 10 miles from its mouth, is situated the capital of the settlement, Paramaribo, where the governor resides, and where, also, most of the government establishments are situated. The principal exports of the colony are sugar, molasses, rum, and gold. The trade centres almost entirely in Paramaribo, and is chiefly carried on with Holland, the United States, and Britain. In 1863 slavery was abolished in Dutch Guiana, which is said to have had a prejudicial effect on the colony, which was previously in a flourishing condition. A large portion of the colony belongs to the city of Amsterdam. Pop. in 1900, 68,968, exclusive of the negroes who dwell in the forests and some others. The government is vested in a governor-general and council.

GUIANA, French (French, *Guyane-Française*), a French colony in South America, the most eastern division of Guiana, its coast-line extending from the river Maroni on the west, to the river Oyapok on the east, which separates it from Brazil, a distance in a straight line of about 200 miles. The greatest length of the colony, north to south, is about 280 miles; its greatest breadth, about 220 miles; area, about 47,000 square miles. This territory also resembles that of British Guiana in its physical features, climate, and vegetable productions, with the addition, in the latter case, of pepper, cloves, cinnamon, nutmeg, &c. The coast is low, consisting of a flat alluvial tract of great fertility, in some places marshy, and covered with thick forests of mangroves. The highlands, in the interior—the soil consisting of clay mixed with granitic sand,—are also fertile; and the whole country is exceedingly well watered—the principal streams being the Mana, Sinnamary, Oyak, and Aprouague. The capital of the territory is Cayenne, on a small island, celebrated for the description of pepper bearing that name. The colony is divided into fourteen communes or townships. The government is vested in a governor, assisted by a privy-council, and colonial council of sixteen members, elected by the colonists. Gold-mining is much the most important industry, but other minerals, including silver, iron, and phosphates, are also worked. Other important exports are rum, cocoa, coffee, and various woods. Since 1885 the colony has been mainly a penal settlement.

The French are said to have first settled in Cayenne in the year 1604. In 1763 the French government, with the view of improving and otherwise increasing the importance of the colony, sent out 12,000 emigrants; but no arrangements having been made for their reception or subsequent disposal, they nearly all perished from exposure to the climate, which was then extremely insalubrious. In 1809 the colony was captured by the united forces of the British and Portuguese, but restored to France at the Peace of Paris in 1814. Pop. in 1901, 32,908.

GUICCIARDINI, Francesco, a celebrated historian, born at Florence, May 6, 1483, of a family of high rank; died at Arcetri, a suburb of his native city, May, 1540. He studied law with such success that in his twenty-third year (1505) he was chosen professor of jurisprudence at Florence. In 1512 he was appointed ambassador to the court of Ferdinand the Catholic, of Spain. At a later period he was invited by Leo X. to his court, and intrusted with the government of Modena and Reggio. This office he discharged also under Adrian VI., to the general satisfaction; and afterwards, when Clement VII. (de' Medici) ascended the Papal chair, Guicciardini was sent, as lieutenant of the pope, to Romagna, then torn by the factions of the Guelfs and Ghibellines and infested by robbers, where by a severe and upright administration of justice, he soon succeeded in restoring tranquillity. He also contributed here in other ways to the public good, by constructing roads, by erecting public buildings, and by founding useful institutions. Having been appointed lieutenant-general

of the pope, he, in 1521, defended Parma when besieged by the French. After the death of Giovanni de' Medici, Guicciardini was invited by the Florentines to succeed him in the command of the famous *bande nere*; but the pope still claimed his services for a time. Having quelled an insurrection in Bologna, he returned, in spite of the desires of the holy father, to his native city, where, in 1534, he began his great work on the History of Italy (extending from 1490 to 1534), which has since been repeatedly published, and has obtained for him great reputation. In his retirement he was not without some influence on state affairs, and his wise counsels often restrained the prodigality and the ambition of Alessandro de' Medici, who esteemed him very highly, as did likewise Charles V., whose interests he had promoted in his negotiations at Naples. In 1537 he contributed greatly to the elevation of Cosmo de' Medici to the office of grand-duke. Two editions of the History of Guicciardini, on which his fame rests, were published at Florence in 1561, with the title Dell' Istoria d'Italia libri XVI. Four other books appeared in 1564, but these are merely rough drafts. The best edition is that published at Freiburg in four vols. 4to, in 1775–76. Numerous other editions have appeared. It was translated into English by the Chevalier A. P. Goddard, and the translation published at London between 1753 and 1761. The reader of Guicciardini is sometimes offended by a want of method. A more important defect, however, is that his statements cannot always be depended on as derived from the best sources. A collection of his hitherto unpublished works appeared at Florence between 1857 and 1867. A translation by N. H. Thomson of his Counsels and Reflections was published in 1890.

GUICOWAR'S (or GAIKWAR'S) DOMINIONS, or BARODA, a native state in Hindustan, included in the Bombay presidency, directly subordinate to the government of India, consisting of detached portions of the province of Gujerat; the whole between lat. 20° 40′ and 21° N., and lon. 69° and 74° E.; having on the south-west the Indian Ocean; north, the Gulf and Ran (or Runn) of Kach (Cutch), and the territories of Udeypur, &c.; east, some minor Rajput states and a part of the Bombay Presidency proper, which last surrounds the districts on the east and north of the Gulf of Cambay; area, 8750 square miles. The chief rivers are the Sabarmati, Mahi, Narbadi, and Tapti. The country is generally a level plain with fertile soil, and there are practically no hills. It is one of the richest parts of India, and its admirable position, with a long line of coast, is highly advantageous to its commerce. It is now connected by railway with Bombay. Cotton, sugar-cane, indigo, tobacco, oil, opium, flax, are the principal crops; in some parts there are fine pasture lands; and the eastern districts in particular are productive of various kinds of grain, more of which is produced than required for home consumption. The inhabitants are chiefly Hindus, but include many Mohammedans and Parsees, with wild aboriginal tribes; the Jains, a religious sect of western India, are here very numerous. The dynasty is Mahratta. A treaty was first entered into between the Guicowar and the East India Company in 1780. The tribute of the Guicowar to the British is fixed at eight lacs of rupees (say £80,000) annually. Baroda is the capital, and the seat of the British resident, who conducts all the foreign relations of the state. In August, 1871, Mulhar Rao ascended the throne, but proved himself an incapable and oppressive ruler. In July, 1874, the British government of India allowed him a period of seventeen months to reform the abuses that prevailed in his government; but, as matters meanwhile grew worse instead of better, and since he was suspected of having in the interval instigated an attempt to poison the British resident, he was deposed in 1875, and a ruler was nominated from another branch of the family, in the person of Syaji Rao. The number of Parsees in Baroda is greater than in any other place except Bombay and Surat. Pop. (1891), 2,414,200; (1901), 1,950,927.

GUIDES, in an army, persons selected for their acquaintance with the topography of the region in which the army operates, and employed to conduct the army or detachments of it to any place which has to be reached. But the name 'guides' is sometimes given to troops without any very specific meaning. In the army of British India it is given to a regiment of cavalry and infantry attached to the Punjab frontier force.

GUIDO ARETINO. See ARETINO.

GUIDO RENI, a celebrated Italian painter, born near Bologna in 1575; died there August 18, 1612. His father, Samuel Reni, an excellent musician, at first intended that his son should devote himself to music, for which he showed some talent; but he soon discovered in the boy a greater genius for painting, and had him instructed by the Dutch artist Dionysius Calvaert, who was then in high repute at Bologna. In this celebrated school Guido is said to have studied chiefly the works of Albert Dürer. This becomes probable if we consider some of his earlier works, in which, particularly in the drapery, occasional resemblances may be traced to the style of that artist. In the meantime the school of the Caracci, at Bologna, on account of its novelty and superior taste, began to eclipse the former, and Guido joined it in his twentieth year. He soon gave his teachers occasion to admire his talents, and is even said to have excited the jealousy of Annibal Caracci. Guido's desire to behold the treasures of art in Rome induced him, about 1602, to visit that city with two of his fellow students, Domenichino and Albano. There he saw some of the paintings of Caravaggio, who was greatly admired for his powerful and expressive (though often coarse and low) manner, which Guido imitated. His reputation soon spread, and Cardinal Borghese employed him to paint a crucifixion of St. Peter for the church Delle Tre Fontane. The powerful manner of this picture, and several others of the same period, which Guido did not, however, long retain, increased his fame; and when, at the cardinal's request, he completed the Aurora, so beautifully engraved by Morghen, the admiration was universal. Paul V. at that time employed him to embellish a chapel on Monte Cavallo, with scenes from the life of the Virgin Mary. Guido accomplished this work to the satisfaction of the pope, and was next intrusted with the painting of another chapel in Santa-Maria-Maggiore. These works were followed by so many orders that he was unable to execute them all. To this period his Fortuna, and the portraits of Sixtus V. and Cardinal Spada, may be assigned. Guido's paintings are generally considered as belonging to three different manners and periods. The first comprises those pictures which resemble the manner of the Caracci, and particularly that of Caravaggio. Deep shades, narrow and powerful lights, strong colouring, in short, an effort after great effect, distinguish his works of this first period. The second manner is completely opposed to the first, and was adopted by Guido himself as a contrast to the works of Caravaggio, with whom he was in constant controversy. Its principal features are light colouring, little shade, an agreeable though often superficial treatment of the subject. It is quite peculiar to Guido. His

Aurora forms the transition from the first to the second style of his paintings. A third period commences at the time when Guido worked with too much haste to finish his pieces, and was more intent upon the profits of his labour than upon its fame. It may be distinguished by a greenish gray, and altogether unnatural colouring, and by a general carelessness and weakness. During the government of Pope Urban VIII. Guido quarrelled with his treasurer, Cardinal Spinola, respecting the price of a picture, and returned to Bologna. There he had already executed his St. Peter and Paul for the house Zampiere, and the Murder of the Innocents for the Dominican church, and was on the point of embellishing the chapel of the saints with his pictures when he was called back to Rome, loaded with honours, and received by the pope himself in the most gracious manner. But he soon experienced new difficulties, and in 1622 accepted an invitation to go to Naples. Believing himself unsafe at this place, on account of the hatred of the Neapolitan artists against foreign painters, he returned once more to his native city, never to quit it again. At Bologna he finished the chapel above mentioned, painted two beautiful pictures for the church Dei Mendicanti, an Ascension of Mary for Genoa, and a number of others for his native city and other places, particularly for Rome. The most celebrated work of Guido is his Aurora, painted on a ceiling in the hall of the Rospigliosi Palace at Rome. It represents Apollo in his car, attended by the Hours, and preceded by Aurora. There is also a fine painting of a Magdalen by this artist in Chiswick House, belonging to the Duke of Devonshire, of which there is an engraving by Sir Robert Strange. Equally celebrated is a painting of Lot and his Daughters, in the Hampton Court collection, also engraved. In the gallery of the Louvre are several, of which the finest is the Centaur Nessus carrying off Dejanira. Guido was also celebrated in his own day for his etchings, but his works of this class have now sunk very much in value.

GUIENNE, or GUYENNE (corrupted from *Aquitania*, of which the district afterwards called Guienne formed a part), an ancient province of France, comprising the Bordelais or Guienne proper, Bazadais, Agénois, Périgord, Quercy, and Rouergue. The territory of this province now comprises the departments of Gironde, Lot, Lot-et-Garonne, Dordogne, and Aveyron, with part of Landes and of Tarn-et-Garonne. The capital was Bordeaux. It belonged to the kings of England from 1152 till 1377, when it was nearly all conquered and annexed to the French crown under Charles V. It was again occupied by the English under Henry V. and Henry VI., but they were finally expelled in 1453.

GUIGNES, JOSEPH DE, a French orientalist, born at Pontoise in 1721; died at Paris, March 19, 1800. He studied oriental languages under Fourmont, after whose death, in 1745, he was appointed oriental interpreter to the royal library. In 1753 he was chosen a member of the Academy of Belles-lettres. In the same year he was appointed royal censor, and in 1769 keeper of the antiquities in the Louvre. He applied himself particularly to the study of the Chinese characters; and comparing them with those of the ancient languages, he thought he had discovered that they were a kind of monograms, formed from three Phœnician letters, and therefore concluded that China must have been peopled by an Egyptian colony. The Journal des Savans, and the Memoirs of the Academy, he enriched, during the space of thirty-five years, with a great number of contributions, which display profound learning, great sagacity, and many new views. He was reduced to poverty by the revolution; but even in this situation he retained his equanimity, his disinterestedness, and his independence, which would not allow him to receive support from any one. Among his numerous works, the first place belongs to his Histoire Générale des Huns, des Turcs, des Mongols, et des autres Tartares Occidentaux (Paris, five vols. 1756–58). In this work, the materials for which he had drawn from valuable, and, in part, untouched stores of eastern knowledge, to which he had gained access by a profound study of the languages, much light is thrown upon the history of the caliphates, of the Crusades, and generally of the eastern nations. His Mémoire dans Lequel on Prouve que les Chinois sont une Colonie Égyptienne is of great value. Translations of the Chou King (by Father Gaubil), one of the sacred books of the Chinese, and of the Military Art among the Chinese (by Amyot), were revised and published by De Guignes, besides other pieces, and twenty-eight papers in the Memoirs of the Academy, and contributions to the Notices et Extraits de la Bibliothèque Royale.

GUIGNET'S GREEN. This fine colour is prepared by heating in a reverberatory furnace a mixture of three parts of boracic acid and one of bichromate of potassium, made into a thick paste with water. The mixture boils up, decomposition ensues, and a bright green borate of potassium and chromium is formed, which, while still red-hot, is raked into water. The salt decomposes, a potassic borate dissolves, and the chromic oxide combines with water, forming a rich green colour, which is afterwards reduced to a suitable state of division. This colour is quite fixed—it does not alter by light or reagents, and it is quite harmless, so that it forms an excellent substitute for the greens which contain arsenic and copper.

GUILD, a society, fraternity, or company, associated for carrying on commerce or some particular trade. The merchant guilds of our ancestors answer to our modern corporations. The societies of tradesmen exclusively authorized to practise their arts, and governed by laws of their own constitution, played a very important part in the middle ages. Few institutions show the progress of civilization in a stronger light than that of guilds, from the first rude mixture of all kinds of labour, its division, the establishment of corporations, the corruption of these by privileges which are in some cases highly absurd, down to their total abolition and the restoration of liberty to human industry. These divisions by occupations or castes generally took their rise from a difference of national origin, as with the Egyptians, Indians, &c. The Romans had various mechanical fraternities (*collegia et corpora opificum*), but these seem to have been merely religious and political societies; while the associations of workmen in the arsenals that existed under the empire were regular hereditary castes, enjoying certain privileges and bound to certain duties. In Italy, the cradle of the class of free citizens in the middle ages, and particularly in the Lombard cities, those connecting links between the ancient and modern civilization, some remains of these Roman institutions, or recollections of them, probably contributed to revive the guilds, which naturally presented themselves as an excellent means of supporting the citizens against the nobility by uniting them into powerful bodies. With the increasing importance of the cities, which became the seats of industry, and with the establishment of their constitutions, begins also the extension of guilds. The chief reason that mechanical industry was freely developed in the middle ages, at the same time with agricultural, which had been chiefly cultivated by the Greeks and Romans, was the independence which the mechanics acquired with the growth of municipal and civil liberty. Mechanical industry has always been essentially of a democratic character, and would

never have flourished under the feudal system. It is not possible now to give the exact date of the origin of these societies in Upper Italy. Traces of them are found in the tenth century. Thus, in Milan, we find the mechanics united under the name *credentia*. It is certain that small societies existed as early as the twelfth century, which appear, in the following century, to have been in the possession of important political privileges. When the advantages of these associations became known and felt they rapidly increased; and in the struggles of the citizens and the nobility the principal resistance against the latter was made by the corporations. As soon as the citizens acquired an influence on the administration the guilds became the basis of the municipal constitutions, and every one who wished to participate in the municipal government was obliged to become the member of a guild. Hence we find so often distinguished people belonging to a class of mechanics, of whose occupation they probably did not know anything. This mixture of social and political character, as well as the insignificance of the individual, considered merely as such, is a natural consequence of the rudeness of the period. Just principles are the work of time. It is only by slow degrees that the true is separated from the false, the essential from the unessential. Political, like religious and scientific principles, are at first always vague and incoherent. Men must have long experience of the concrete before they form just notions of the abstract. Thus it is a characteristic of the middle ages that political rights were considered as arising from special privileges. All that men enjoyed was looked upon as a gift from the lord paramount. In fact the idea of the rights of man, as an individual, has been developed only in very recent times. Even the ancient republics had no just conception of it. In Germany the establishment of guilds was also intimately connected with that of the constitutions of the cities. The latter were different according as the ancient Roman or the old German organization of the community prevailed; the relations among the mechanics were also very different. The mechanical arts were at first chiefly practised by the villeins; and even in the time of Charlemagne they appear to have been pursued on the estates of the feudal lords by the bondsmen. Although there early existed free mechanics, yet they were also, except in cities of Roman origin, such as Cologne, under the protection and jurisdiction of the feudal lord, before the privileges of the cities were acknowledged. These privileges early secured to them, as a distinct class of vassals, a sort of organization under the direction of the masters of each trade, as appears from the oldest law of the city of Strasburg, which seems to belong to the fifteenth century; and out of this the guilds in Germany may have originated.

The full development of the guilds in Germany falls in the last half of the twelfth century; but they possessed no political importance in Germany before the thirteenth century. At this time they acquired the right of bearing arms for the defence of their own interests, and when a struggle arose between them and the citizens belonging to ancient families the guilds were victorious, and became so powerful that even persons of 'free occupations' joined these associations as the allodial possessors of land sometimes placed themselves under feudal lords. The by-laws of the German guilds contained regulations as to the training of apprentices, the practice of one's trade in different towns as a journeyman, and the requirements of a master. The corporations of merchants and mechanics became more and more confirmed in their privileges and monopolies, whilst the country people suffered by being made in many respects the slaves of the guilds. Particular branches of industry were often subject to restrictions in favour of the guilds which were sometimes of a most offensive nature. The guilds became insupportable aristocracies, sometimes allowing only a certain number of master mechanics in the place, and seldom admitting any one into their associations except favourites of the masters. The examinations for the admission of a journeyman to the rank of a master were used as a means of extorting money, and were often combined with the most absurd humiliations. In some parts of Germany there were from four to five different guilds of smiths, which did not allow each other the use of certain tools. At an early period these workmen's associations met with opposition, but the opposition was not at first directed against them on account of the obstacles they threw in the way of commercial intercourse, and the other evil consequences of their monopoly, but simply on account of their political influence. With the view of destroying this the Emperor Frederick II. abolished them by a decree issued in 1240; but the decree remained without effect, as did also the clauses inserted with a similar view into the Golden Bull in 1356. In the eighteenth century several edicts were made in Germany against the abuses of the guilds, and at different dates in the nineteenth century freedom was granted in most of the states of Germany to all to practise any trade without being admitted into a guild. In Austria this was done in 1860, and in 1868 it was done for all the states of the North German Confederation.

In Britain the societies of mechanics were important principally in a political respect, on account of their connection with the democratic element of the constitution. These societies originated in Britain, as on the Continent, at the time of the development of the importance of the cities. In the towns where they long existed they had an important influence in the election of representatives, and in the municipal administration. The rights of a 'freeman,' with which was associated the privilege of voting in the cities or boroughs, were often confined to the members of these societies, of which the membership was obtained by serving an apprenticeship or by purchase. As the principal privilege of these societies consisted in this right of voting, persons not mechanics were frequently admitted members to give them this privilege. These guilds, in England, had no legal right to prevent any man from exercising what trade he pleased. The only restriction on the exercise of trades was the statute of Elizabeth, requiring seven years' apprenticeship. This the courts held to extend to such trades only as were in being at the time of the passing of that statute; but by the act 5 and 6 William IV. cap. lxxvi. s. 14, every kind of restriction on artisans, trades, &c., was abolished. The guilds of the city of London (among the oldest of which are the weavers, founded in 1164; the parish clerks, in 1232; the saddlers, in 1280; the fishmongers, in 1284; the goldsmiths, in 1327; the skinners, in 1327; and the grocers, in 1345) are still very important corporations, still continuing to fulfil the chief object for which they were founded—that of giving relief to poor and decayed members, and also having in many cases the management of vast funds bequeathed for benevolent purposes by persons who selected one or other of the guilds as trustees. Sometimes these funds are bequeathed for specific purposes, which the guilds, as trustees, are of course bound to carry out; but in other cases, where they are available for general purposes, the guilds have usually shown great discretion in the manner in which they have employed them. Besides the secular guilds or mechanics' associations there were from a very early

period, in Britain, religious guilds, resembling the religious societies of modern times. From the time of Henry II. all such guilds were required to have a charter from the crown. In 1388 a return of these guilds was ordered to be made, and it was then found that that of Corpus Christi, York, numbered 14,800 members. Some of the most objectionable features of the ancient guilds have again been developed by some of the trades-unions, their modern representatives. For the history of guilds see Toulmin Smith's English Guilds, and Walford's Guilds.

In France guild-privileges were sold by the state from the tenth century till the revolution of 1789, and the position of the artisan had come to be a most pitiable one; but at that date every restriction on the exercise of any trade was removed. This was done also at a later period in Belgium, Holland, Italy, Sweden (1846), and Denmark (1862).

GUILDFORD, a town of England, county town of Surrey, on a declivity which slopes to the Wey, 29 miles south-west of London. It is well built, and has altogether a substantial and thriving appearance. The churches are old, and one of them, St. Mary's, an ancient and interesting structure, was restored in 1863. The guild hall dates from 1683, and there is a hospital founded in 1619. The principal school is the grammar-school, an ancient collegiate establishment founded in 1509, though the present building was erected only in 1889. The Guildford Institute; county-hall and assize-courts; county hospital, erected in memorial of the prince consort in 1866, should also be mentioned. The Norman keep and some other parts of the former castle still remain. There are iron-foundries, breweries, and flour-mills. The town has some trade with London in corn, timber, malt, &c., sent by the Wey. Previous to 1867 Guildford returned two members to Parliament, and from that year till 1885 it sent one. It now gives name to one of the six parliamentary divisions of Surrey. Pop. in 1891, 14,319; in 1901, 15,937.

GUILDHALL, the city hall of London, King Street, Cheapside, first built in 1411, all but consumed in the great fire of 1666, and in 1669 rebuilt. The front was not erected until 1789. The most remarkable room of this edifice is the hall, 153 feet long, 48 broad, and 55 high, used for city feasts, the election of members of Parliament and city officers, and for all public meetings of the livery and freemen. Monuments, erected at the expense of the city, to the memory of Lord Nelson; William Pitt, earl of Chatham; William Pitt, his son; and Beckford, lord-mayor in 1763 and 1770, whose celebrated reply to his majesty George III. is engraved beneath, ornament this hall. It also contains the celebrated wooden statues of Gog and Magog (which see). In another room, that of the common council, is a collection of pictures, some of great merit.

GUILLEMOT (*Uria*), a genus of web-footed birds, of the family Alcidæ (the auk family). The guillemot, like the other auks, has a smooth, straight, compressed, and pointed bill, and has no hallux or hind-toe. Its wings are pointed and very short, being scarcely long enough to enable it to fly. It lives on fish and crabs, and builds its nest on precipitous rocks adjoining the sea. It is found chiefly in northern regions, and is an excellent diver and swimmer. The common guillemot (*Uria troile*) is frequently met with on the coasts of Britain. It is about 18 inches in length, of a dusky slate-colour above and white beneath, and it has also a white bar across each wing. It lays one very large egg. Those which breed on the shores of Britain migrate southwards in autumn, when their place is taken by others coming from a still more northerly region. Another species is the black guillemot (*Uria grylle*), which is smaller than the other. In summer this species is entirely black, except on the wings, where there is a large white spot. In winter it is mottled all over with white. It breeds farther north than the common guillemot, and lays two or three eggs at a time. Another species (*Uria lacteolus*) is entirely white. It is not found in Britain. See illustration at ORNITHOLOGY.

GUILLOCHE, in Grecian architecture, an ornament consisting of straight or curved bands symmetrically interplaited.

GUILLOTINE, an instrument for beheading, so called from its reputed inventor, Dr. Joseph Ignace Guillotin, and introduced during the French revolution. It consists of two posts united at the top by a cross beam, and furnished with grooves, in which a broad steel blade heavily weighted with lead descends by the impetus of its own weight on the neck of the criminal, fastened to a plank beneath. The certainty and speed with which this instrument separates the head from the body gives it an advantage over the axe or sword wielded by the hand. Machines of a similar description have been in use among many nations. In Italy, from the thirteenth century, it was the privilege of the nobility to suffer capital punishment by an instrument called the *mannaia*, closely resembling the guillotine. In Germany likewise, during the middle ages, an instrument resembling the guillotine was made use of, though the blade did not fall upon but was thrust through the neck of the criminal. There was formerly employed in Great Britain also, and more especially in Scotland, an instrument of decapitation called the *maiden*, said to have been introduced by Regent Morton, who himself afterwards suffered by it. It differed from the guillotine in this, that while the blade of the guillotine falls upon the neck of the criminal, in the maiden the blade is fixed with its edge upwards, and the neck of the criminal is forced down upon it by the fall of a heavy weight. Such an apparatus was also known and used at an early period in France. The Dutch likewise formerly made use of a decapitating machine. It has been satisfactorily ascertained that Dr. Guillotin was not only not the inventor of the instrument which bears his name, but had only a secondary share in its introduction into France. As a member of the constitutional assembly he proposed to that body to abolish all class distinctions in the method of inflicting capital punishments, and with that view to have some instrument invented which might do the work more quickly and certainly than the hand of the headsman. The establishment of a new penal code having now become the subject of deliberation, a vote for a uniform system of capital punishment was, on the motion of Dr. Guillotin, passed on 21st Dec. 1789, with a recommendation that the least painful method of inflicting it should be adopted. It was not till 1792, however, that this special machine was selected after a report from Dr. Ant. Louis, secretary to the College of Surgeons. The guillotine was first erected in the Place de Grève at Paris, and the first execution performed by it on 25th April, 1792, on a highwayman. Shortly afterwards, in remembrance of Guillotin's original proposition, it received the name of *Guillotine*, both popularly and in official language, and it was introduced wherever the penal code of France has been adopted. —The name is also given to a machine which cuts by a knife descending between grooved posts, used for paper, straw, &c.

GUIMARÃES, a town in Portugal, 26 miles north-east of Oporto. It is well built, has ancient walls, remains of an old castle, a fine church with a splendid choir, &c. There are thermal sulphurous

springs here. It is of very ancient origin, and in 1107 was made the capital of the kingdom by Henry of Burgundy. Pop. (1900), 8863.

GUINEA, an English gold coin worth 21*s.* sterling. Guineas were first coined, in the reign of Charles II. (1663), of gold which the English procured from Guinea, and hence the name. Its value was at first 20*s.*, but owing to the gradual depreciation of the silver coinage, and then to its restoration to a fixed standard, the value of the guinea, relatively to that of the silver money of the country, fluctuated greatly until, in 1717, it was fixed at 21*s.* In 1817 the coin was withdrawn from circulation. See COIN.

GUINEA, a name applied somewhat indefinitely to the west coast of Africa from the Senegal to the Cunene. This coast was first explored by the Portuguese, from whom it received the name Guinea; but its subsequent occupation by European powers and the separate naming of their colonies has caused the old name to fall into disuse. The portion of the coast from the Niger delta westwards is called Upper Guinea, and now includes Southern Nigeria, Lagos, Dahomey, Togoland, the Gold Coast, the Ivory Coast, Liberia, Sierra Leone, French Guinea (Rivières du Sud), Portuguese Guinea, Senegambia, and Gambia. Lower Guinea, extending southward from the Niger delta, includes Cameroon, French Congo, and Portuguese West Africa (Angola, &c.).

GUINEA, GULF OF, a great gulf of Western Africa, between Cape Palmas and Cape Lopez, and including the bights of Benin and Biafra. The Guinea Current flows into this gulf from Cape Palmas, abreast of which and near the land it has a velocity of 2 miles an hour; it is lost in the Bight of Biafra, near Prince's Island, lon. 7° E. Fernando Po, Prince's Island and St. Thomas, are the only islands of consequence within this gulf. See GUINEA.

GUINEA, NEW. See NEW GUINEA.

GUINEA-FOWL, or PINTADO (*Numida*), a genus of gallinaceous birds of several species belonging to the pheasant family, so named because common in Guinea, being also found over great part of Africa. The common guinea-fowl (*Numida Meleagris*) was known to the Romans, and has long been common in European poultry-yards. It has a naked head with a hard crest, and has a slate-coloured plumage sprinkled with round white spots. It is about the size of a common fowl, and is of a noisy and quarrelsome disposition. Its flesh is esteemed as food, and still more its eggs, which are of a uniform dull-reddish hue, rather smaller than those of a common hen. Incubation lasts twenty-five days, but the guinea-fowl is a bad sitter, and its eggs are usually given to the common or turkey hen to hatch. Among the other species may be mentioned the *Numida vulturina*, by far the most beautiful, with pointed purple feathers on the lower part of the neck; the *Numida mitrata*, found in South Africa and Madagascar; and the *Numida cristata*, with a crest of curled feathers, and a remarkable appendage at the throat in which the windpipe is convoluted. See illustration at ORNITHOLOGY.

GUINEA-GRASS (*Panicum maximum*), a very tall species of grass, often 6, and sometimes even 10 feet in height, so called because it is a native of Western Africa. The panicles are widely branched, and rough to the touch, being formed of spikelets almost entirely divided into two. The leaves are long, flat, and finely dentate. It has been naturalized in South America and the West Indies, where it is largely cultivated for fodder. It grows even in Britain, but there it is not so productive as in warmer climates.

GUINEA PEPPER. See CAYENNE PEPPER.

GUINEA-PIG (*Cavia cobaya*: 'Guinea is probably a mistake for 'Guiana', and 'pig' is from its grunting), a well-known little animal, a native of South America, domesticated in Europe. It is a mammal of the order Rodentia, and belongs to the cavy family (Caviidæ). It is a restless, grunting little creature, showing a small amount of intelligence either in the wild or tame condition; and is of little or no use to man for food or otherwise. It feeds on bread, grain, fruit, or vegetables, giving a decided proference to parsley, and is exceedingly cleanly in its habits. It breeds when only two months old, and generally brings forth every two months, having from four to twelve young ones at a time; hence the produce of a single pair might be a thousand in the year. In the space of twelve hours after birth the young are able to run about.

GUINEA-WORM (*Filaria Medinensis* or *Dracunculus*), a long thread-like worm, which is found in intertropical regions of the Old World, and has been introduced into parts of the New, usually infesting the sub-cutaneous cellular tissue of man. The male is unknown; the female is of about the same thickness as the tube of a pigeon's quill, and varies in length from less than 6 inches to 13 feet, it is said, or even more. The tail runs to a point, and is curved backwards in the form of a hook. The mouth is circular. The egg is developed in the interior of the parent, and with the aid of a microscope the young animal may be seen rolled up in a coil, sometimes with the tail projecting in a straight line. During the period of growth this animal causes very little inconvenience to the person beyond an unpleasant itching sensation; sometimes it may remain for months, or even, as some assert, for one or two years, without occasioning any uneasiness; but at a certain stage of its development it begins to make its presence manifest. A small tumour appears, surmounted by a transparent or dark-coloured vesicle, which becomes violently inflamed, and causes great pain. In a short time a small opening is made at the top, and the worm begins to show itself. It comes forth, however, very slowly, and in order to hasten its departure it is cautiously extracted by winding it round a stick or a roll of linen one or two times every day. During this operation the utmost care is necessary, as if the worm breaks the portion which remains beneath the skin produces a formidable exacerbation of the inflammatory state. As a rule twenty days are required to extract the worm completely, but this period is not unfrequently extended to two, three, or even more months. It has recently been discovered that the embryos of the guinea-worm pass into the body of a water-flea (*Cyclops*), whence they may enter the human body in drinking water.

GUINGAMP, a town of France, in the department of Côtes-du-Nord, picturesquely situated on the Trieux, 19 miles W.N.W. St. Brieuc. It is an ancient place, has an old church much visited by pilgrims, a fine fountain, and manufactures of linen, thread, &c. Pop. (1896), 7174.

GUIPUZCOA, one of the three Basque provinces of Spain; area, 728 square miles. The coast is bold and rocky, the interior generally mountainous, with fertile, well-cultivated valleys. The chief riches of the province are in its minerals, particularly iron of excellent quality, argentiferous lead, copper, marble, and gypsum. See BISCAY, BASQUES. Pop. in 1897, 191,822; in 1900. 195,850.

GUISBOROUGH, a market town in England, in the county of York (North Riding), 9 miles south-east of Middlesbrough, situated in a narrow, fertile valley of the Cleveland Hills. It consists chiefly of one broad street. The chief buildings are the parish church (re-seated 1875, further restored 1890), the

town-hall, grammar-school (rebuilt 1887), two hospitals, and the ruins of the priory of Austin Friars, founded in 1129. Pop. (1891), 5632; (1901), 5645.

GUISCARD, ROBERT (that is, *Robert the Cunning*), Duke of Apulia and Calabria, a son of the celebrated Tancred de Hauteville, was born in Normandy in 1015. When he grew up he proceeded with a band of adventurers to Italy, where his brothers William, of the Iron Arm, Dagobert, and Humphrey had already acquired large possessions in which Robert hoped to share. Robert soon distinguished himself in many battles; and the soldiers, moved by his exploits, unanimously proclaimed him, in 1056, after the death of his brother Humphrey (the last survivor of the three above-mentioned), count of Apulia—a dignity which he accepted without hesitation, although to the prejudice of the rights of his brother's children. He then conquered Calabria, in the possession of which he was confirmed by Pope Nicholas II., who had previously excommunicated him for some sacrilegious outrage, but had been won over by the show of reverence and submissiveness which Robert made. Nicholas also made him gonfalonier of the church, enfeoffed him with all the territories which the Normans had conquered or should in future conquer in Lower Italy, thus repeating the grant which had been made by Leo IX. to Humphrey, and sanctioned his assumption of the title of duke. Robert, grateful for this favour, bound himself to pay to the holy see an annual sum; and from this arose the feudal claims of the Papal see on Naples, which existed till the termination of the kingdom. In Apulia Guiscard ruled with absolute power, and soon began to think of conquering Sicily, the investiture of which the pope had already promised him. He sent his youngest brother, Roger, at the head of 300 resolute warriors, to take possession of this island. Robert followed his brother into Sicily about the year 1061, and the two brothers united defeated the Saracens on the plains of Enna. Roger conquered nearly the whole of the island, and became the first count of Sicily. Robert, in the meantime, besieged all those cities in Lower Italy which as yet were in the hands of the Greeks or Saracens. Some of these detained him a long time; as, for instance, Salerno and Bari, before the latter of which places Guiscard was encamped nearly four years (1068–71). In 1074 he was excommunicated by Gregory VII. for refusing to take the oath of allegiance; but he nevertheless continued his wars and conquests in Lower Italy until Gregory was convinced of the advisability of securing his friendship by concession. Thereupon Robert took the oath of allegiance required of him, and was freed from the ban of excommunication (1080). Gregory now called upon him for aid against the Emperor Henry IV., but Robert was by this time engaged in a new enterprise. The betrothment of his daughter Helen to Constantine Ducas, the son and heir of the emperor Michael VII., had given him an opportunity of interfering in the affairs of the Greek Empire. Michael VII. having been deposed, the Byzantine crown was at this time contested by several claimants, the chief of whom (besides Michael himself) was Alexius Comnenus (see ALEXIUS), and Robert fitted out a considerable fleet in aid of Michael, his daughter's father-in-law. He sent his son Bohemond to the conquest of Corfu, while he himself went to attack Durazzo. A tempest and a contagious disease had nearly frustrated this expedition. Alexius Comnenus approached with superior forces. In 1081 the armies joined battle under the walls of Durazzo, where the victory at first inclined to the side of the Greeks; but the courage of Guiscard gave the battle a different turn. Durazzo was compelled to surrender. Robert penetrated into Epirus, approached Thessalonica, and filled the capital with terror. In the midst of this victorious career he was recalled by the information that Henry IV., emperor of Germany, had entered Italy. He gave the command to Bohemond, and hastened home to assist Gregory VII., who was besieged in the Castle of St. Angelo, against the Germans. Henry IV. was compelled to retreat; Gregory was released, and conducted to Salerno as a place of safety in 1084. Guiscard now hastened again to Epirus, where he repeatedly defeated the Greeks. By means of his fleet he also made himself master of many of the islands of the Archipelago, and was upon the point of advancing against Constantinople, when he died in the island of Cephalonia, July 17, 1085.

GUISE, a town of France, in the department of Aisne, beautifully situated on the left bank of the Oise, 25 miles by rail from St. Quentin. It is strongly fortified, has an old castle, and carries on various industries, manufacturing paper, stoves, soap, &c. It is an ancient city, having been mentioned as early as 1050. In 1444 it was erected into a county, and in 1528 into a duchy. (See the following article.) Pop. (1896), 7945.

GUISE, a distinguished ducal family of France, a branch of the house of Lorraine. The founder of the family was Claude, a younger son of René II., duke of Lorraine, who in 1506 became naturalized in France, and in 1513 married Antoinette de Bourbon, the daughter of the Count of Vendôme. In his favour the county of Guise (which was one of his numerous possessions in France) was erected in 1528 by Francis I. into a duchy. He died in 1550, leaving behind him five daughters (the eldest of whom, Marie, married James V. of Scotland, and was the mother of Mary, queen of Scots) and six sons—François (*Le Balafré*, see next article), who succeeded him in the duchy of Guise and his other dignities; Charles (usually known as Cardinal of Lorraine), Louis (Cardinal of Guise), Claude, François, and René, all of whom were persons of note. The family acquired great political importance on the accession of Francis II., who was married to Mary, queen of Scots. François, the second duke of Guise, was assassinated in 1563, and left three sons, Henri (also called *Le Balafré*), who inherited his father's titles; Louis, cardinal of Lorraine and archbishop of Rheims (both put to death in 1588 on the command of Henry III.); and Charles, duke of Mayenne. Henri, the third duke of Guise, was succeeded by his son Charles, who died in Italy in 1640, and was succeeded by his second son Henri. Henri died without issue in 1664, when he left the title to his nephew, Louis Joseph, duke of Joyeuse and Angoulême. His son and successor, François Joseph, died in 1671, leaving only one son, who died at the age of five in 1675, when the direct line of the house of Guise became extinct. In 1704 the title was revived for the house of Condé.

GUISE, FRANÇOIS DE LORRAINE, DUKE OF, born in 1520, and called *Le Balafré* (the Scarred), from a wound which he received in 1545 at the siege of Boulogne, and which left a permanent scar on his face. He showed distinguished courage in 1552–53 at Metz, which he defended with success against Charles V., although the emperor had sworn that he would rather perish than retreat without having effected his object. He again distinguished himself at the battle of Renti in 1554. He also fought with success in Flanders and in Italy, and was named lieutenant-general of all the royal troops. In 1558 Calais was taken from the English, with the territory belonging to it, and next year the treaty of Cateau Cambrésis was concluded. Under Henry II., whose

sister he had married, and still more under Francis II., he was the virtual ruler of France. Then grew up the factions of Condé and Guise. On the side of the latter stood the Constable of Montmorency and Marshal de St. André; on the side of the former were the Protestants and Coligny. The Duke of Guise, a zealous Catholic and an enemy to the Protestants, determined to crush them by the sword. At Vassy, on March 1, 1562, he found a number of Calvinists assembled for worship in a barn. His party insulted them; they came to blows, and nearly sixty of those unhappy people were killed and 200 wounded. This unexpected event lighted the flame of civil war throughout the kingdom. The Duke of Guise took Rouen and Bourges, and won the battle of Dreux, Dec. 19, 1562. On the evening after this victory he remained, with entire confidence, in the same tent with his prisoner, the Prince of Condé, shared his bed with him, and slept quietly by the side of his rival, whom he regarded as a relation and a friend. He was preparing for the siege of Orleans, the central point of the Protestant party, when he was killed by a pistol-shot fired by Poltrot de Méré, a Huguenot nobleman, Feb. 1563. We possess his memoirs written by himself.

GUISE, HENRY, Duke of Lorraine, eldest son of the preceding, was born in 1550, and was a bitter enemy of the Huguenots. He displayed his courage in the battles of Jarnac and Moncontour, both gained over the Huguenots in 1569. His prepossessing appearance made him a general favourite. Under the pretence of defending the Catholic faith he advised the cruel massacre of St. Bartholomew (1572). From motives of personal revenge he took upon himself the assassination of Coligny, whom he called the murderer of his father. In 1576 was formed the League, first projected by his uncle, the Cardinal of Lorraine. For this purpose it was proposed to the most zealous citizens of Paris to join in a league, which had for its avowed object the defence of religion, of the king (Henry III.), and of the freedom of the state, but in reality tended to the oppression both of the king and the nation. A period of civil war followed, which was only temporarily put an end to by the peace concluded at Flex in Périgord, Sept. 12, 1580. The desertion of the king to the opposite party determined the Duke of Guise to renew the league, and to take measures in concert with Pope Gregory XIII. to exclude Henry of Navarre from the throne. In March, 1585, he occupied with the troops of his party all the towns in the south and west of France, and in July compelled the king to agree to a treaty according to which no religion but the Catholic should be tolerated in the kingdom. This led to the war of the three Henries, in which the King of Navarre totally defeated the army of the league at Coutras, Oct. 20, 1587. After this defeat the Duke of Guise, fearing the fickleness of the king, brought about a rising of the Catholics in Paris (May, 1588), with the object of seizing his person. Although the king escaped, the duke was able to induce the queen-mother to accede to a second treaty, with the object of rooting out the Protestants in France, which Henry III. himself afterwards confirmed. Flushed by this triumph he became imprudent, and clearly showed that he aimed at the throne. When the states were summoned to meet at Blois, for the sake of giving the final ratification to the treaty just concluded, the king consulted with some of his confidants as to the best means of getting rid of the duke, and all believing that it was impossible to effect this by means of a regular trial, determined upon his assassination, and this purpose was actually carried out in the king's cabinet at Blois, Dec. 23, 1588.

GUITAR, a stringed instrument, the body of which is of an oval-like form, and the neck similar to that of a violin. The modern or Spanish guitar has six strings, the three highest of gut, the three lowest of silk covered with fine wire, and tuned to the E in the second space of the bass staff, A, its fourth, and the treble D, G, B, and E. The intermediate intervals are produced by bringing the strings, by the pressure of the fingers of the left hand, into contact with the frets fixed on the key-board, while those of the right pluck or twitch the strings. The Spaniards, the reputed inventors of the guitar, derived the name they give it, *guitarra*, from *cithara*, the Latin denomination for almost every instrument of the lute kind. The people of Spain are so fond of the guitar that there are few, even of the labouring class, who do not solace themselves with its practice.

GUJERAT, GUJRAT, or GUZERAT, a maritime province of Western India, in the Presidency of Bombay. The south-west portion is in the form of an extensive peninsula, with the Gulf of Kach (Cutch) on the north-west side, and the Gulf of Cambay on the south-east. The central districts form an extensive plain, generally well watered, open, and fertile, but the northern and eastern districts are mountainous, rugged, and jungly, and numerous deep ravines intersect many of the flattest portions of the country. Gujerat is traversed by several large rivers, of which the Narbada, Myhe, and Sabarnati are the most important; but in particular tracks water is so scarce that wells of 100 feet in depth must be dug to obtain it. The climate is hot in summer, but mild in winter, and not unhealthy even for Europeans. During the hot and dry months the surface of the country mostly appears sand or dust, and in the rainy season a thick mire; but it is extremely fertile. The natural productions include cotton, sugar, indigo, tobacco, hemp, and opium—the last to a limited extent only. Horses and bullocks of a superior description are reared. The greater portion of this province, including nearly the whole of the peninsular part, is under native princes, the chief of these being the Guicowar of Baroda; the central portions are British. The population of this portion of India presents an extraordinary assemblage of sects and castes. The area of the British portion, comprising the districts of Surat, Broach, Kaira, Panch Mahals, and Ahmedabad, is 10,082 square miles, and the pop. (1891), 3,097,540; total area, 70,000; pop. over 11,000,000.

GULDEN, a coin of Austria-Hungary and of Holland, nominally equal to the English florin. The name was also applied to several coins formerly current in Germany and other countries.

GULES, the heraldic name for red. In engraved escutcheons it is represented by vertical lines. See HERALDRY.

GULF-STREAM. See CURRENTS.

GULF-WEED consists chiefly of several species of *Sargassum*, a genus of sea-weeds of the group Fucaceæ, which abound in some tropical seas, and are especially abundant on the shores around the Caribbean Sea, both those of the mainland of South America and the West India Islands. These sea-weeds consist of branched and dark olive-green plants, the branches bearing distinct leaves, in the axils of which grow berry-like air-vessels on short stalks. Prodigious accumulations of these plants were encountered by the early Portuguese and Spanish navigators. Columbus, who compared them to extensive inundated meadows, said they retarded the progress of his vessels and threw the sailors into consternation; and no doubt they may have an appreciable effect on a vessel's progress when in

sufficient quantities. Such accumulations occur especially in the North Atlantic, where a large stretch of ocean has long been known by the name of the Sargasso Sea. This lies between North Africa and the West Indies, and the area where the seaweed is most abundantly to be met with lies between the meridians of 40° and 75° west, and the parallels of 20° and 35° north. Humboldt describes two banks of sea-weed in the North Atlantic Ocean, but this view is questionable. The supposition that the weeds proceed with the Gulf-stream from the Gulf of Mexico is what has given the weed its name, and that they are carried by currents and winds to the place where they are found floating in such abundance seems to be now settled, as well as that they have originally grown on rocky shores, and have been detached by the violence of the waves. They vegetate for a time while floating, but reproduction does not take place, and they gradually die and sink, to be replaced by others.

GULL, the general name of various species of web-footed birds belonging to the genus *Larus* and other genera included in the sub-family Larinæ of the family Laridæ. These birds are almost universally spread over the globe. They are distinguished by their straight bill, bending downwards towards the point, and marked below the under mandible by a triangular prominence, by their light body, supported by large wings, by slender legs, palmated feet, and a small hind toe. Generally seen in large flocks, the larger species frequent the sea, the smaller, lakes or rivers. They walk with tolerable ease, and swim well, but are incapable of diving. They keep much on the wing, and their flight is rapid, strong, and long sustained, even in heavy gales. In sitting they contract their neck and rest on one foot. They are extremely voracious, fighting with each other for prey. They will feed on every kind of animal food, either dead or alive, putrid or fresh. Their principal food, however, is fish, of which they will follow the shoals; they catch them with great agility, darting down like an arrow. They breed only once a year, laying from two to four eggs. The species are exceedingly numerous, and greatly resemble each other. The gulls are continually fighting with each other, and the strong plundering the weaker, the latter even after having swallowed its prey being oftentimes obliged to disgorge it, when it is seized by one of the pursuers before it can reach the water. The facility which the gulls have of vomiting their food has been taken notice of even in their captive state. Some of these birds have been tamed, but even then they have always discovered the same quarrelsome and voracious habits. The principal species in the west of Europe are the Common Gull, *Larus canus*, which breeds on coasts, or inland in moory districts; the Lesser Black-backed Gull, *L. fuscus*, which is very common in Britain, much more so than the Greater Black-backed Gull, *L. marinus*; the Black-headed Gull, *L. ridibundus*, of which the Masked Gull, *L. capistratus*, is only a variety; the Ivory Gull, *L. eburneus* (or *Pagophila eburnea*); the Short-legged Ivory Gull, *Pagophila brachytarsus*; the Iceland Gull, *L. Islandicus*, distinguished by its white quill-feathers from the Herring Gull, *L. argentatus* (see illustration at ORNITHOLOGY); the Burgomaster, *L. glaucus*; the Little Gull, *L. minutus*; Sabine's Gull, *Xema Sabini*; and the elegant Kittiwake, *Rissa tridactyla*. The Skua also deserves mention.

GULLET. See ŒSOPHAGUS.

GUM, a substance which exudes spontaneously from the bark of certain trees, such as the plum, the peach, the cherry, and the acacia; but in many instances incisions have to be made in the bark to facilitate the flow. Gum, as thus obtained, forms non-crystalline rounded drops or tears, the purest varieties being transparent or translucent, of a pale-yellow but sometimes of a dark colour, and containing chips of wood and other impurities. Gum is soluble in water, forming a very stable, thick, smooth fluid, with considerable adhesiveness; it is insoluble in alcohol. By the former of these properties gum is distinguished from mucilage (which see), by the latter from resin (which see). Gum has no odour, and only a very faint taste. It has a slight toughness up to a certain point, and thereafter it is brittle; the fracture is resino-vitreous. A solution of gum is lævorotatory; by boiling with dilute sulphuric acid it is ultimately changed into one of a dextrorotatory sugar. By treatment with nitric acid gum is converted into oxalic and mucic acids; with lime or alkalies it gives various decomposition products. The exact nature of gum is not yet definitely settled; the purest of all, gum-Arabic, contains inorganic matter, and this has led to the opinion that it is a compound with bases of a substance called gummic acid; but this acid is found to be similar in composition to sugar, and the closest connection exists between the two classes of bodies. The different kinds of gum receive their names from the countries from which they are imported—such as gum-Arabic, gum-Senegal, gum of Bassora, Barbary gum, East India gum, Chagual gum, &c. Besides these are gum-tragacanth, cherry-tree gum or French gum, red gum; and the name is sometimes inaccurately applied to dextrine, benzoin, elemi, copal, olibanum, ammoniacum, and other bodies.

GUM-ARABIC. As mentioned in the article GUM, this is the purest form of gum, and may be regarded as typical of the gums. It is the product of many different species of *Acacia* (especially that known as *A. Senegal*), which are found wild throughout Northern Africa from Senegal to Nubia, and in other countries. The gum exudes spontaneously, and its appearance, according to botanical authorities, is an indication of the tree being in an unhealthy condition; but in order to get it in a sufficient quantity the bark is cut into, and the gum collected. It is chiefly imported from Alexandria, Cairo, and the Red Sea. Gum-arabic is very largely employed in the finishing and dressing of fabrics, especially of silks; for thickening the colours in calico-printing, though British gum is often substituted; in pharmacy for making lozenges, pills, and emollient drinks; as a cement; in ink-making; for making crayons and water-colour cakes, and for many other purposes. The purest gum-arabic is in round tears, transparent, and almost colourless, faintly odorous, slightly sapid, readily powdered; specific gravity, 1·3 to 1·48; completely soluble in water, the solution being feebly acid. It is coagulated by alcohol, and by a variety of metallic salts. The precipitate with alcohol consists of the pure gum, and is called *arabin*. It has the composition denoted by the formula $C_{12}H_{22}O_{11}$, but is only isomeric, not identical, with cane-sugar. This body is the most widely spread of all the gummy principles, as it occurs in almost all varieties of gum.

GUMBINNEN, a town of Eastern Prussia, capital of the government of the same name, on both sides of the Pissa, 68 miles east of Königsberg. It is of comparatively recent origin, regularly built, and indebted for its rise and prosperity to the asylum which it afforded to persecuted Protestants, chiefly those of the Duchy of Salzburg. It has Lutheran, German, and French Reformed churches, manufactures of woollen and linen cloth, and a trade in corn, wool, cattle, &c. Pop. in 1895, 13,545.—The government, area 6125 square miles,

is flat, extensively covered with heath, but in many parts well wooded, and remarkable both for the number and magnitude of its lakes. Pop. (1900), 792,240.

GUM-BOIL, an abscess in the gum caused by inflammation, generally the result of toothache or of the presence of decayed teeth or stumps. The treatment consists in leeching or scarifying the gums and then inhaling the steam of warm water, or washing the mouth with borax dissolved in warm water. The carious tooth or stump, if the inflammation proceeds from this cause, should be removed. When matter has formed it should be evacuated by a free incision, and the mouth should be frequently washed with tincture of myrrh and water.

GUM-RESINS are very complex mixtures obtained from plants. As the name implies, they contain both a gum, which is soluble in water, and a resin, which dissolves in spirit, so that the body usually is nearly quite soluble in dilute alcohol; but there are usually present in addition essential oil, colouring and extractive matter, and a variety of impurities. The gum-resins have frequently a strong and characteristic taste and smell, and active physiological properties. They are solid, opaque, and brittle. The common gum-resins are aloes, ammoniacum, asafœtida, euphorbium, galbanum, gamboge, myrrh, olibanum, opoponax, sagapenum, and scammony. See separate articles.

GUMTI, or GOOMTI, a river of Hindustan, rises in the hills of Rohilkhand, and flowing south-east through Oude, enters Behar, and falls into the Ganges between Ghazipur and Benares. In its course it passes the cities of Lucknow and Jaunpur, and after passing the latter becomes extremely tortuous till it enters the Ganges. Its entire length in nearly a straight line is about 350 miles. There are other rivers of the same name, particularly one which rises in Tipperah and falls into the Brahmaputra.

GUN, a strongly-constructed metal tube, from which destructive projectiles are expelled by the gradually increasing pressure of gas, evolved from fired gunpowder or other explosive. The term comprehends every description of firearm, from cannons, mortars, and other heavy pieces of ordnance, to the fowling-piece, rifle, and pocket-pistol. The present article is restricted to great guns or cannons of modern type, other species of firearms being described under the articles MUSKET, REVOLVER, RIFLE, MACHINE-GUNS, &c. Some historical and other particulars will be found under CANNON.

In common with every other mechanical construction, the gun in its improvements has followed the progress of the mechanical arts and metallurgy; concurrent have been the improvements forced on by progress in the manufacture of gunpowder. The earliest guns now in existence show longitudinal bars hooped round with wrought-iron coils, and the light artillery of Gustavus Adolphus had an interior copper tube wound round tightly with strips of hide. Heavy ordnance or cannons latterly were made of bronze or iron cast hollow in one piece—improvements in the casting of metal bringing this about. In 1859, Armstrong, taking advantage of the improved facilities in the manipulation of large metal forgings, reintroduced the ancient construction. Over a wrought-iron barrel were shrunk successively wrought-iron coils, increasing in thickness about the breech. Afterwards the wrought-iron of the barrel and of some of the interior coils was superseded by steel. In 1882 the British Ordnance Committee recommended that all ordnance should be entirely of steel. In 1890 the wire construction (as described below) was recommended, it having been previously advocated by Longbridge, Blakely, Mallet, and Armstrong about 1855.

Principle of Gun Construction.—When the powder charge is exploded, we may regard the powder-chamber, where the greatest pressure is, as a closed cylinder containing gas under great pressure, one end of the cylinder being the bottom of the bore and the other the base of the projectile. The pressure of the powder-gas causes in the gun, (1) a longitudinal thrust, which is met by simply locking the hoops and tubes together; (2) a circumferential tension, which requires some mathematical calculation. The cylindrical shell of a boiler being thin, the maximum circumferential tension, that is at the interior, is approximately equal to the average tension; but in a gun or a hydraulic press the thickness of the metal is considerable, and thus the maximum tension is considerably greater, and is limited by the strength of the metal. The British Ordnance Committee laid down that the limits of tension should not exceed 18 tons per square inch for a hoop and 15 tons per square inch for the inner tube.

Barlow, in 1825, gave a formula, connecting hoop tension and radial pressure in a hoop or tube of homogeneous metal, when the external pressure is inconsiderable. Later on Rankine gave the general formula when both the internal and external pressures are arbitrary. This formula shows that no thickness of metal is sufficient to stand an internal pressure greater than its working tension, if the circumferential extension of the tube is unsupported; which fact accounts for the bursting of some immense mortars. Hence modern guns have layers of exterior reinforcing hoops, each shrunk on with an appropriate initial tension. Great economy of material is effected if all the circumferential fibres take up a uniform tension when the gun is fired; but this means an increase in the number of coils, and hence enormous cost and complication. However, by winding steel wire round the tube, with appropriately varying tension, all parts of the wire coils take an equal share in resisting the firing stresses. The employment of wire permits much larger working tension, its test going up to 100 tons per square inch. The hoops or wire coils are put on with the *initial* stresses or stresses of *repose*, so that the addition of the *powder* stresses, called up by the internal powder-gas pressure, produces the final *firing* stresses.

Muzzle-loaders and Breech-loaders.—Up to modern times all guns were muzzle-loaders, but the principle of breech-loaders has been known for centuries, as is seen from specimens in museums; however, the mechanical arts were not sufficiently advanced to justify their general manufacture, so muzzle-loaders kept in vogue. In 1859 Armstrong's breech-loading system was adopted. Yet in 1863 the British Ordnance Committee stated 'that the preponderance of opinion seems to be against any breech-loading system'. At that time the simplicity of construction of muzzle-loaders, the absence of the necessity for obturation, and the violent gunpowders, were powerful arguments for this retrograde conclusion; consequently the British authorities went back to muzzle-loaders. Subsequently the new slow-burning powders that were introduced necessitated longer guns, and the difficulties of loading at the muzzle increased; hence in 1879 breech-loaders were reintroduced into the British service. Breech-loading guns involve the consideration of obturation, and that of breech mechanism, including firing-locks.

Obturation.—Obturation is the prevention of any

escape of gas between the breech-stopper and the powder-chamber. The earlier Armstrong R. B. L. (rifle breech-loading) guns relied upon the mechanical fit of two conical copper surfaces, a separate tin cup assisting in the heavier ordnance. The French Colonel de Bange's system, adopted in 1882, consists of an asbestos pad, threaded on a steel spindle, passing through the breech screw, the axis of the spindle being hollow to form a vent (see the breech mechanism shown in Pl. I.). The mushroom-formed head of the spindle or steel vent being acted on by the powder-gas, squeezes out the asbestos against the flat surface of the breech-screw, and thus any escape of gas is sealed. The tin cup of the rifle breech-loading (R. B. L.) and the elastic steel Broadwell L-shaped ring of Krupp guns may be considered the same in principle as the base portion of a metallic cartridge-case, which forms a gas-tight joint; similarly the L-shaped leathers of an hydraulic press seal the escape of the liquid. Formerly it was thought that the stickiness caused by the imperfect elasticity of asbestos prevented its use in a quick-opening breech action, but the new Vickers 6-inch quick-firing gun firing 5 rounds a minute with bared cartridges, has an asbestos obturator. The obturation of other Q. F. (quick-firing) guns, as also of machine-guns and small-arms, is effected by a metallic cartridge-case, which has also the advantage of containing the means of igniting the powder-charge. The earlier rifle breech-loading (R. B. L.) guns of Armstrong had the breech closed by a separate movable steel stopper, put in loosely by hand through a slot at the top or the side. The stopper was kept tight against the end of the bore by a breech-screw provided on its surface with a continuous thread, which worked in a corresponding thread cut in the interior of the gun behind the slot for the stopper; hence many turns of the screw were required to tighten up the breech-stopper. Krupp guns have a cylindro-prismatic or C-shaped wedge, which is put in at a side opening with its flat end next to the end of the powder-chamber, and is tightened up in its place by a screw at its side. The present British breech-loading guns have the 'interrupted screw' system, the old R. B. L. breech-stopper being done away with. The breech-screw has its screw surface broken by four to six longitudinal smooth strips, and there are corresponding screwed and smooth strips in the interior of the bore at the breech. By placing the screwed relief portions of the one opposite the smooth sunk portions of the other, the breech-screw is locked in the gun by an eighth or a twelfth of a turn.

In opening a breech on the interrupted-screw system there are three distinct principal operations: (1) rotating the breech-screw in order to bring the screwed strips parallel to the plain ones; (2) withdrawing it in its axial direction; (3) rotating it clear of the breech-opening to permit of the introduction of the cartridge and projectile. In closing the breech the order of the operations is reversed. Underlying the principal operations are the minor ones of securing the breech-screw in the firing position, of ejecting the empty cartridge-case (when there is one), of placing the firing-lock into its position, and of cocking it; for all of which automatic provision is more or less made. Automatic arrangements are also made that the gun cannot be fired until the breech is (1) locked fully home, and (2) the lock is in its firing position, supporting the head of the firing-tube, which is placed in the entrance of the vent. In order to support the breech-screw when withdrawn, there is a bracket or ring, attached to the gun by a hinge with a vertical bolt, round which the carrier supporting the breech can be swung.

The withdrawal of a long cylindrical breech-plug causes some delay. In the Elswick 4·7-inch and 6-inch quick-firing guns, this long withdrawal is avoided by tapering the front part of the breech screw to admit of its being readily swung into the loading position, after the withdrawal of the short cylindrical portion. The three principal operations were first effected by three distinct motions; afterwards, by a combination of levers, the three motions were reduced to one.

Improvements in breech mechanism mean mainly a quicker opening and closing action. In the earlier manufactured breech-loading guns the principal operations are performed in three distinct motions. In the 3- and 6-pounder Nordenfeldt and Hotchkiss quick-firing guns, the breech can be closed or opened (including the minor operations) in one motion, but their mechanism is not well suited for heavy guns. Being for naval and coast service, the sighting arrangement could be placed on the fixed portion of the mounting, quite clear of the service of the gun, which, provided with a shoulder-piece, could be fired like a rifle. The rate of firing at a standing target is about 20 to 30 rounds per minute; but practically at a swift-moving target the rate is reduced to about 10 rounds or less a minute. Black powder, on account of its smoke, still further reduces the rate. Under GUN-CARRIAGE, it will be seen that the question of a quick-firing gun is bound up with the design of its mounting.

It is evident that on the interrupted-screw system the smooth strips reduce by one-half the screwed bearing-surfaces, which alone oppose the gas blowing out the breech-screw; hence, in 1899-1900 the British authorities adopted the system of the Swede Welin (introduced by the firm of Vickers-Maxim). The bearing-surfaces were increased by the device of arranging the segments at varying diameters, the breech-opening being prepared in a corresponding manner. The interruptions in the gun are arranged to accommodate the segments of the screw of largest diameter; thus, when the screw is unlocked, these segments pass into the interruptions, and the segments next smaller in diameter unlock into the spaces left vacant by the larger ones. In the case of the 6-inch gun there are six segments, and four of them are threaded, that is, two-thirds of the circumference is used to resist the strain of firing. Consequently the breech-screw can be shortened, which reduces the weight and length of withdrawal, and increases the length of bore for same weight of gun.

In 1889, the French firm of Canet exhibited guns in which the three principal breech operations were effected by the continuous rotation of a hand-wheel at the end of a worm actuating a series of toothed gearing. A toothed pinion actuated a toothed quadrant formed on the exterior face of the interrupted screw, and turned it in the unlocked position, when a longitudinal rack on the breech-screw came in gear and the latter was withdrawn, and then in its turn the toothed arrangement for rotating the carrier-ring supporting the breech-screw came into play. On reversing the direction of rotating the hand-wheel the breech was closed. Levers are quickly applied in light and medium breech mechanism, but tend to become clumsy in heavier guns. Toothed gear is slow, but powerful and compact. Experience has worked out a compromise for the British service.

The breech-screws of the heavier guns are difficult to unscrew on account of their weight and the jamming of the obturating arrangements by large

powder charges. In order to get over this difficulty, a powerful 'Stanhope lever' or knuckle-joint was introduced in 1886 for the British 9·2-inch breech-loader and guns of higher natures. This is primarily a mechanism of four links connected by four pivots; three of the links rotate, and one remains fixed. In descriptions the links and pivots may be disguised under the form of cranks, cams, &c. The lengths of the levers are so adjusted as to give immense leverage at one pivot. On one pivot of the fixed link is formed a ratchet-wheel, which the ratchet-lever works by means of a double pawl, and the lever combination unscrews the breech-plug. A separate power-gaining apparatus withdraws or pushes home the breech-plug. This is effected by a toothed pinion, keyed to the vertical hinge-bolt of the carrier, gearing into a rack let into the side of the breech-plug—the hinge-bolt being revolved by another toothed pinion, which itself is worked by a worm and hand-wheel arrangement. When the end of the rack is reached the breech-plug becomes automatically fixed to the carrier, and the effect of the motion then is to swing them both clear of the loading.

The horizontal swing of the hand-lever of the Vickers-Maxim 6-inch quick-firer (see Plate I.) in one motion rotates (locks or unlocks) the breech-plug and swings it clear of the gun. The arrangement for actuating the breech-plug consists of a link, one end of which is pivoted on a pin projecting from the face of the breech-plug; the other end is pivoted to a short crank which is mounted on the breech-plug carrier. Around the boss of the hand-lever, which is pivoted on the carrier, is a 'skew-gear' wheel, which gears with skew teeth formed on the boss of the short crank. As applied to the new British 9·2-inch and higher natures, the Vickers-Maxim breech mechanism differs from that of the 6-inch in having a worm-wheel on the carrier hinge-bolt, actuated by means of a worm and hand-wheel, which are fitted to a bracket on the breech mechanism frame. All the three principal operations are performed by the continuous motion of the hand-wheel.

Wire Gun.—Plate III. shows the section of the 9·2-inch wire breech-loading gun, constructed of steel tubes, of layers of steel wire, and a jacket. The A tube is lined with the usual inner A tube hammered home to corresponding shoulders. A steel breech-bush is screwed into the A tube at the rear; an eroded inner A tube can be replaced by a new one. Successive layers of flat wire are wound round the A tube, the ends being secured to steel rings. The B tube fits over the exterior of the wire. The jacket is fitted over the wire and a portion of the B tube, and is secured longitudinally by corresponding shoulders on the B tube and a screwed steel-bush at the rear. The wire is wound on the gun by revolving the A tube in a lathe. One end of the wire is fixed to the tube, so that the wire unreels from a drum on to the tube. The tension of the winding on is regulated by a weight and lever arrangement; it may vary from 35 to 50 tons per square inch at the commencement and about 20 to 35 at the finish, according to the design of the gun. The inside winding tensions become gradually relieved by the tensions of the outer layers as the winding proceeds, so that each layer finishes off exactly at the 'tension of repose', calculated to meet the condition that on firing the gun the wire-coils are uniformly strained. The section of the wire is about ·06 inch in thickness by ·25 inch in width. The 12-inch breech-loader, the largest British wire gun, has as much as 100 miles of wire round its A tube.

Rifling.—A rifled gun has spiral grooves cut in its bore, into which, on its being fired, projections (lead coat, copper studs, gas-checks, or driving-bands) on the projectile are forced, and serve to give it a spin. Thus the gun can fire an elongated projectile heavier than a spherical shell, and less influenced by the air-resistance. The spin round the longer axis keeps its point foremost, otherwise it would turn end over end. Similarly a top spins upright, its point resisted by the ground. Continental museums show that rifled small-arms which took spherical bullets were known from an early date. In their case the spin increases the accuracy by equalizing the air-resistance on the foremost surface. Benjamin Robins first suggested, in 1747, an elongated, egg-shaped bullet. Professor Greenhill, F.R.S., of Woolwich, about 1878 published a mathematical formula, from which the minimum twist at the muzzle of the gun requisite to give stability of rotation can be calculated for any elongated projectile. In his formula the velocity does not appear. The spiral grooving or twist is either (1) uniform, when the inclination of the grooves to axis of the bore is the same throughout; (2) increasing, when the inclination increases towards the muzzle, the intention being to reduce the strain at the commencement of rotation; (3) combination, as in the 9·2-inch breech-loading, the grooving being first straight and then increasing. it is now found that with a given projectile the same twist about suits high and low velocities. Thus, the 5-inch breech-loading gun with a velocity of 1750 feet per second, has a twist of 1 in 25 calibres; and the 5-inch howitzer, with a velocity of 782 feet per second, has a twist of 1 in 28 calibres. In high-angle fire the motion tends to become unsteady, as during descent the trajectory becomes more curved. Projectiles that have a right or a left spin drift towards the right or left respectively. The 9·2-inch breech-loading shell fired at a range of 22,000 yards drifted about 1000 yards to the right. The time of flight was about 70 seconds, the maximum height ascended was calculated to be about 19,000 feet. The angle of elevation of the gun for this range was 45°; it is conjectured that the greatest ranges would be obtained in these very long trajectories by firing at elevations over 45°, as the shot is thereby carried more rapidly through the lower denser strata of the atmosphere.

Internal Ballistics.—Internal ballistics mean the investigation of the relations connecting the pressure, volume, and temperature of the powder-gases and the work done by the expansion of the powder in the gun. A preliminary study is to record the pressure obtained by exploding powder in a closed explosion vessel, varying the air-spacing or the gravimetric density, which tells the number of cubic inches allotted to each pound of gunpowder. Benjamin Robins, of the East India Company, initiated such experiments in 1743; Chevalier D'Arcy in 1760, and Count Rumford in 1792, followed. Sir A. Noble and Sir F. Abel (1875–94) have obtained more modern results with explosion vessels reinforced by windings of steel wire. In these experiments the gas acting upon the piston of an enclosed crusher-gauge compresses a small copper cylinder about half an inch in length, the pressure in tons per square inch corresponding to any reduction of length, as measured to $\frac{1}{1000}$th of an inch by a micrometer, is then read from a table, compiled from the compression of similar cylinders under known weights. The compression of springs is likewise employed to indicate powder pressure. Among the results, Noble found that 1 lb. of black powder exploded in an air space of 46·5 cubic inches exerts a pressure of 15·5 tons

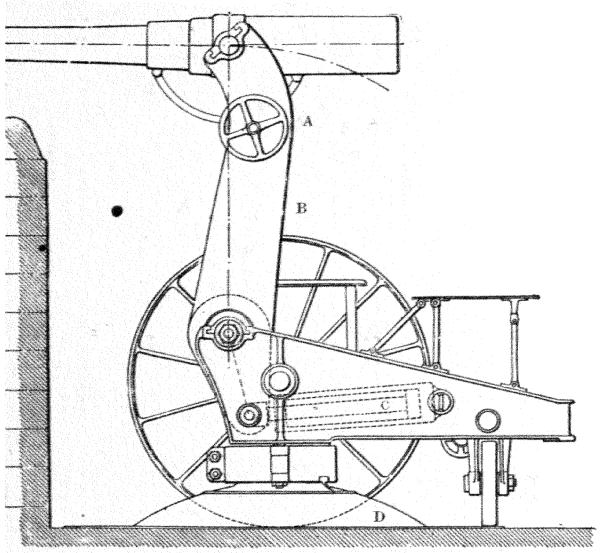
per square inch, and the pressure of 1 lb. of exploded cordite was 63 tons per square inch; but when the air space was increased to 465 cubic inches, the pressures for pebble powder and cordite fell to 1 and 3·8 tons per square inch respectively.

Noble, from these experiments, plotted a curve, which graphically shows the numerical connection between the pressures exerted by 1 lb. of powder and the corresponding air-spacings; he thence deduced the amount of work in foot-tons capable of being done by 1 lb. of powder in expanding from one air-spacing to another, and put the result in a table. As a practical example, take the 252-lbs. powder-charge of the 10-inch breech-loading gun firing a 500-lbs. shot: the cubic capacity of the powder-chamber is 8730 cubic inches, which means that each pound of powder occupies 33 cubic inches; the capacity of the bore is 29,300 cubic inches, which means that each pound of the products of combustion occupies 116 cubic inches in the bore. From Noble's table, taking in account the work lost by expansion in the chamber, we find that each pound of the exploded powder, in expanding from 33 to 116 cubic inches, does 68 foot-tons of work, or the 252-lbs. charge does 17,136 foot-tons of work in the bore on the projectile. In other words, the force of explosion could lift 17,136 tons vertically through 1 foot. An increased air-spacing in the powder-chamber lowers the pressure in far greater proportion than the muzzle velocity; hence heavier charges in enlarged powder-chambers obtain higher muzzle velocities without increase of chamber pressure. The work done on the projectile equals its energy; hence the muzzle velocity is calculated to be 2480 feet per second, but if actually found by the electric chronograph of exterior ballistics, it is 2040 feet per second, which gives the effective work done by the powder on the projectile as 14,520 foot-tons. Thus, only 85 per cent of the theoretical work has been realized, the loss of energy being due to friction of the rotating band, communication of heat to gun, &c.

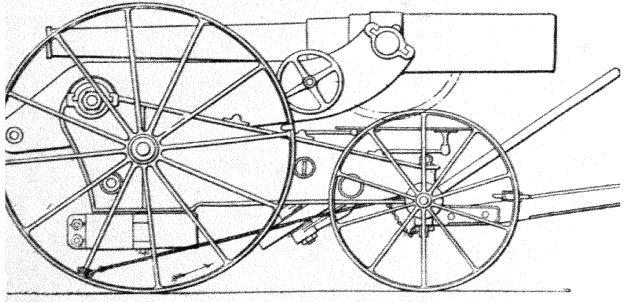
Noble further experimented with guns themselves. The crusher-gauges were screwed into holes made through the metal along the bore at regular intervals (see Plate III.). The pressures of the gas indicated by the compression of the copper cylinders, were checked by calculating them independently from the velocities of the shot in its passage along the bore, as found by an electric chronograph or chronoscope. In this way Noble found (1894) that a 6-inch breech-loading gun, 50 calibres long, with 27½ lbs. of cordite, gave a velocity of 2794 feet per second. When lengthened to 100 calibres or 50 feet, its velocity increased to 3284 feet per second. The increase of velocity by 490 feet per second increased the energy in foot-tons from 2794 foot-tons to 7478 foot-tons, or a net increase of 4684 foot-tons. Thus, when a gun is fired, the relation between the pressure and volume of the powder-gas can be represented graphically on an indicator diagram, similar to that of a steam-engine.

The employment of wire has certainly given a greater margin of safety as regards the pressure, but the wear and life of a gun with modern large charges is now the serious problem. The wear increases enormously with the velocity. Similarly to the case of the steam-engine, a large increase of power gives only a small increment of speed after a certain limit. In a 6-inch, 45-calibre gun a charge of 18 lbs. of cordite gives a velocity of 2500 feet per second; whilst 25 lbs. is needed to give 2800 feet per second, or an increase of 39 per cent in the charge adds only 12 per cent to the velocity.

Exterior Ballistics.—Exterior ballistics refer to the projectile after leaving the bore. Tartaglia in La Nuova Scientia, in 1554, refuted the idea that the projectile started in a straight line. Galileo in 1638 proved that the trajectory of an unresisted projectile was a parabola. His parabolic theory is still useful in the solution of problems of high-angle fire from howitzers and mortars with very low velocities, as in this case the resistance of the air can be neglected and only the attraction of gravity considered. The reverse is the case in problems of direct fire. Newton in 1687 dropped glass spheres filled with air, water, or mercury from the dome of St. Paul's Cathedral. He assumed that the retarding air-resistance had two factors, (1) the square of the velocity, (2) with same velocity the surface or square of the diameter: hence from the observation of the time of falling the height (220 feet), he calculated the resistance of the air. Robins, in 1740, invented his ballistic pendulum, which is essentially a large pendulum provided with an iron plate or a box filled with sand: the bullet strikes the plate, or else the cannon-ball is imbedded in the sand. The amount of the angular recoil of the pendulum being measured, the striking velocity of the ball is calculated. Newton's results were confirmed for velocities below 850 f.s. (feet per second), but above 1200 f.s. the resistance was about three times the amount calculated on assumption (1). Until the time of Robins it was never realized that such a subtle elastic medium could offer so enormous a resistance, in spite of a caution put out by Newton. Between 1865–70, and again 1878–79, the Rev. F. Bashforth fired shots through a series of wire screens, 150 feet apart, in connection with his electric chronograph—an instrument with a rapidly revolving lamp-blacked cylinder or discs, marked by a clock or tuning-fork, which gave regular intervals of time. The projectile thus interrupted an electric current, passing in the wires, which are connected with a Ruhmkorff coil; the currents, thus induced, cause electric sparks to dot bright spots on the lamp-black. Since the markings of the clock or tuning-fork give the rate of rotation of the cylinder or discs, the distances between successive bright spots give the times between successive interruptions of the current in the screens. Thus the *retardation* or rate of decrease per second of the velocity of projectiles of known weights in pounds, between the successive screens, can be calculated, and hence the corresponding retarding air-resistances are known in pounds per square inch. In interior ballistics, the wire carrying the current passes through plugs screwed into the metal of the bore of the gun (see Plate III.), and the projectile in its passage actuates knives which cut the wires. In this case the *acceleration* or rate of increase per second of velocity of projectile is found, and, consequently, the accelerating force of the powder-gas in tons per square inch on the projectile during the successive intervals between the plugs is also known. Bashforth confirmed Newton's second assumption. However, he was not able to discover the exact law connecting the retarding force of the air and the velocity of the projectile. He found that at high and low velocities the law, that the resistance of air varied with the square of the velocity, is a good approximation, but between 790 and 1330 f.s. the law did not hold. However, from the numerical data obtained from firing projectiles of various weights and sizes, he was able to tabulate the resistances to a standard 1-inch projectile, for velocities from 100 f.s. to 2800 f.s. As an example, the table shows that the resistances of air to the 1-inch projectile at 1200, 2000, and 2800 f.s. velocities are 6, 17, and 35½ lbs. respectively.



Gun in firing position.



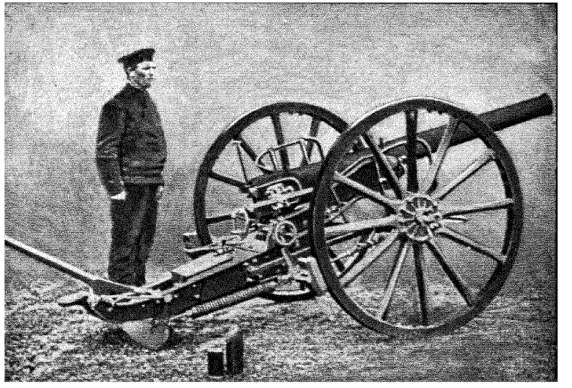
Gun in travelling position.

Gun in travelling position.

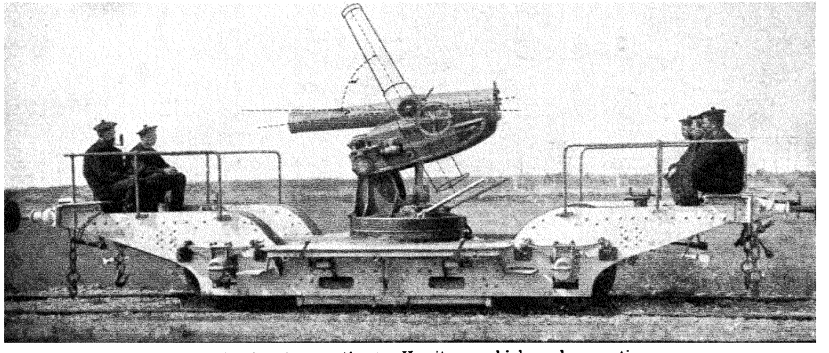
Schneider-Canet (Creusôt) 90-millimetre Gun on disappearing carriage.

References to diagram of Creusôt 90-millimetre Gun.

A, Elevating wheel.
B, Oscillating arm.
C, Recoil cylinder.
D, Cast-steel bolster.

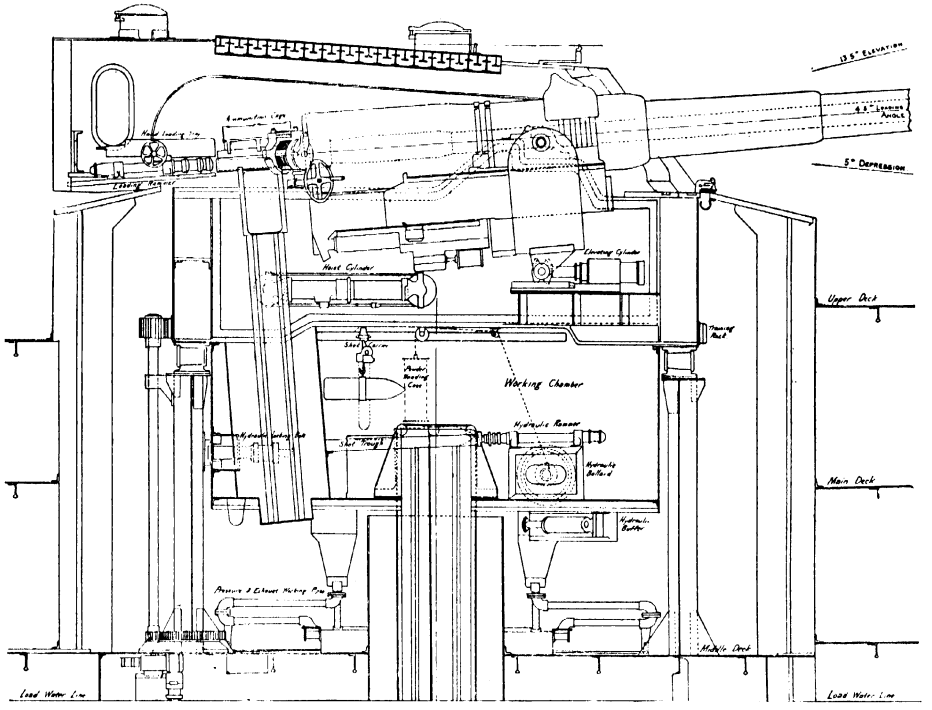


Krupp Q. F. Gun on field-carriage, fitted with oscillating spade and spring brake. Firing position.

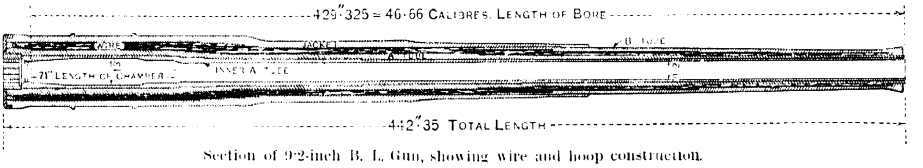


Schneider-Canet 15-centimetre Howitzer on high-angle mounting.

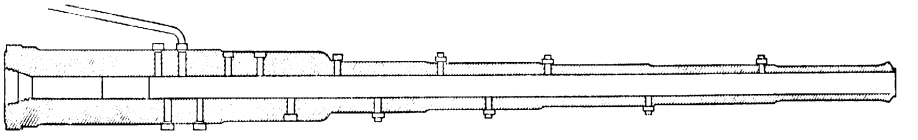
The position of gun immediately *before* or *after* firing, at an angle of 60° above horizontal, is shown in outline. The truck may be used for transit of gun from point to point.



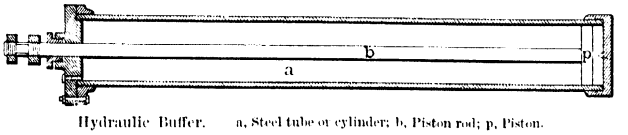
Sectional Elevation of Armstrong's 12-inch mounting (Naval Gun), with all-round loading gear (Japanese warship "Mikasa")



Section of 9·2-inch B. L. Gun, showing wire and hoop construction.



Section of a bore, with crusher gauges and wire-cutting plugs fixed.



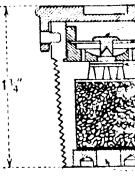
Hydraulic Buffer. a, Steel tube or cylinder; b, Piston rod; p, Piston.

Direct-action Percussion Fuze.

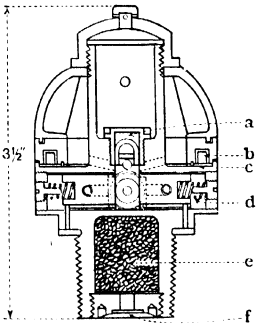
a, Steel needle; b, Copper suspending disc; c, Detonating composition; d, Powder; e, Flash-hole.

Sensitive Time Fuze.

a, Powder; b, Fuze composition; c, Leather washer; d, Spiral spring; e, Powder; f, Flash-hole.



Direct-action Percussion Fuze.



Sensitive Time Fuze.

According to Newton's second assumption, the corresponding resistances for a similar 6-inch projectile would be 216, 612, and 1276 lbs. Thus successive increments of 800 f.s. in velocity have given greater proportional increments in the resistance of the air. It is interesting to calculate that the resistance of the air to the ·303 rifle-bullet at 2000 f.s. is 1½ lb., or forty times the weight of the bullet. From the tables of the resistance of the air are easily calculated others connecting times of flight and velocities, as also ranges and velocities. Thus, by first predicting the muzzle velocity from Noble's table of the work done by the expansion of a pound of exploded gunpowder, we can predict to a fair degree of accuracy all the external ballistics of a projectile to be fired from a proposed gun.

GUN-BOAT, a term originally applied to small craft mounting usually a single gun, and employed exclusively in the defence of coasts and estuaries. Experiences in the Crimean war suggested the extension of the use of gun-boats to offensive warfare. One of the main objects of a ship of war being to carry guns, it was thought that a vessel large enough to carry only a single gun of the largest size would, from the rapidity with which it could be manœuvred, and its comparative immunity from shot, have great advantages in attack against large vessels carrying a heavy armament, and requiring much room and time to manœuvre. About 1860 the British government constructed about 200 gun-boats upon this principle. They were about 100 feet long, with 22 feet beam, and a draught at load-line of 6½ feet. Each was armed with one deck-gun, a 68-pounder of 95 cwts., which, by turning on a pivot, could be used either ahead, astern, or in any other direction; while the facility of manœuvring was further enhanced by the rapidity with which the vessel itself could be turned almost in her own length. Experience soon proved that there were serious defects in this species of armament. One of these was, that from being obliged to carry their guns constantly on deck the gun-boats were liable to be top-heavy and untrustworthy in a heavy sea. A new gun-boat was designed in 1868 by G. Rendel, C.E., the chief peculiarity of which was the placing of the gun on a platform, which could be raised to the deck or lowered to the hold by a donkey-engine. The gun did not turn on a pivot, the manœuvring being effected entirely by the turning of the vessel, to effect which it was fitted with twin-screws worked by independent engines. Other types of gun-boat have since been constructed for the British navy. One of a recent and powerful type is 165 feet in length, with a breadth of 31 feet, and a displacement of 805 tons. It draws 11 feet 7½ inches of water, and has triple-expansion engines, working up to 1200 horse-power, with a speed of 13 knots an hour. It carries six 4-inch steel breech-loading guns, besides two quick-firing guns and machine-guns, and is barque-rigged. A number of what are known as torpedo gun-boats have been constructed for the British navy. One boat of this class is 200 feet in length, with a beam of 23 feet, and a depth of 13 feet. It is built entirely of steel, has a torpedo-tube through the bow and another through the stern in a fore-and-aft line, and one on each broadside forward, a 4-inch 25-cwt. central-pivot breech-loading gun, and six 3-pounder, quick-firing guns. It has two sets of triple-expansion engines, working up to 2700 horse-power, and enabling the vessel of 450 tons to steam over 18 knots an hour. Several first-class gun-boats of a more recent type are twin-screw vessels, 180 feet long, of 700 tons displacement, armed with two 4-inch guns and four 12-pounder quick-firing guns.

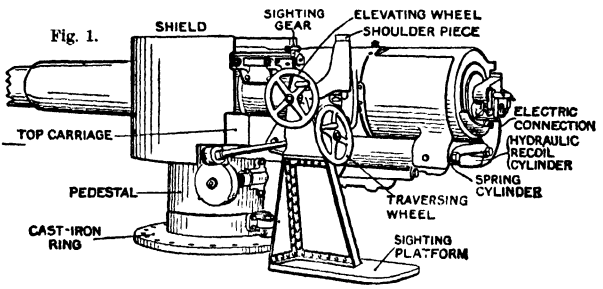
GUN-CARRIAGE, or GUN-MOUNTING, the structure on which a gun is mounted and fired. In such a structure provision should be made for (1) checking the recoil, (2) running up the gun to the firing position after recoil, (3) elevating it, (4) traversing it laterally. The old wooden naval and garrison carriages consisted of two side-pieces or brackets connected by transoms. The gun pivoted vertically by its trunnions in trunnion-holes cut on the top of the brackets. It was elevated by the insertion under its breech of wooden coins or wedges, for which there was subsequently substituted a powerful iron screw, working in a gun-metal socket. Traversing was effected by pushing and lifting the rear of the gun-carriage with wooden handspikes. The carriage was mounted on cast-iron trucks (small wheels) to facilitate transport and running up with handspikes after recoil. An important step of progress was to place the carriage proper on a traversing platform or slide, with an upward slope to the rear to reduce the recoil and facilitate the running up. The latter was effected by means of eccentric rollers worked by hand, the weight being thrown on the front rollers, and the gun and carriage tending to slide down to the firing position. Under the slide, at the front and rear, were placed iron grooved trucks, which ran on concentric metal racers or arcs (whose centres were real or imaginary pivots) let into the emplacement. Handspikes for traversing were superseded by a lever-handle and toothed gearing. The elevating screw gave way to a quick-toothed arc-and-pinion arrangement at the side of the gun and carriage. In course of time iron and steel replaced wood in all parts. A mounting is said to be muzzle-pivoted or central-pivoted, according to the position of its traversing pivot. Muzzle-pivoting allows a large arc of fire with a narrow embrasure. Modern conditions are against such expedients. High explosive shells attack cramped masonry forts very efficaciously. It is better to put guns *en barbette*, that is, firing over long sloping parapets of sand, without rising ground behind to catch shells. Guns painted to match the surroundings and firing smokeless powder are not easily discernible at long ranges.

As regards the extent a gun recoils during the passage of the shot up the bore, and afterwards when the shot has left the muzzle. At a French experiment with Colonel Sébert's velocimeter, it was found that a 24-centimeter gun had only recoiled 1·181 inch during the time it had taken for the projectile to travel up the bore; the velocity of recoil was then 12·86 feet per second, and it attained a maximum of 17 f.s. at a time 0·048 second later. The velocimeter consists of a strip of smoked steel attached to the gun, on which, on recoiling, a wavy line is traced by a point on a fixed tuning-fork, the period of whose vibration is known.

About 1868, the Elswick 'compressor' was designed to control the increased recoil caused by the introduction of heavier powder charges. It utilized the friction between sandwiched iron plates, which are fixed alternately on the top carriage and the slide or under carriage. However, the amount of friction between sliding solids is very variable, hence the 'hydraulic recoil buffer' was introduced to absorb the energy of recoil. It utilizes the fact that the resistance of liquids flowing through small apertures increases more rapidly than the velocity, and is nearly in proportion to the energy of the recoil. Plate III. shows the simplest form of the hydraulic buffer. A piston (P) with holes slides in a metal cylinder filled with oil; one end of the piston-rod is fixed to the carriage proper, the cylinder itself is attached to the 'slide'. On recoil the movement of the piston causes the oil to pass through the holes

from one side to the other. (This, we may mention, is a case of the conversion of mechanical energy into heat, the oil getting heated by the friction.) About 1880 Mr. Vavasseur applied better mechanical ideas in the designs of gun-carriages. In his buffer a rotating valve with ports fits on the piston-rod, just in front of the piston. The ports on the valve differ in form from those on the piston. Studs or projections on the valves work in spiral grooves in the cylinder, hence on recoil the valves rotate and vary the area of the apertures for the passage of the oil. The adjustment is such that at the commencement of recoil the apertures slightly increase in size, and afterwards gradually close. By this method the liquid pressure in the cylinders during the whole time of recoil is more nearly equalized, which means that for a given length of buffer the maximum energy is absorbed with the minimum stress in the mounting. Other manufacturers have adopted other forms of the uniform-resistance brake. The Vavasseur top carriage is formed by a single metal casting, consisting of two hollow brackets connected by a hollow transom. Each bracket forms the cylinder of a hydraulic buffer, the front ends of the piston-rods being attached to the front of the slide. The depth of the top carriage was reduced to such

Fig. 1.



an extent that it became a mere sliding socket containing the gun and two buffers close to one another. By this means the buffers were brought up more in the direction of the force of explosion acting along the axis of the gun, and a destructive cross breaking strain was lessened. The first Vavasseur design left the direction of the axis of the gun forming an angle with the direction of its recoil, and the gun remained after recoil at the rear of the slide. In the descriptions of the 6-inch breech-loading gun and howitzer, it will be seen how these defects are obviated. It is not intended here to assert claims for prior invention, for generally successful designs have had something previous to go upon.

Fig. 1 represents a 6-inch breech-loading gun and mounting of the latest type, embodying in their combination the requirements of quick-firing. The design is now being applied to heavier ordnance. Instead of trunnions, the gun has longitudinal projections fitting in featherways cut in a top carriage or cradle. The gun can freely recoil axially in the cradle, which underneath forms an hydraulic buffer with two cylinders on each side containing powerful springs to assist in limiting the recoil. The reaction of the springs returns the gun automatically to firing or loading position. The elevating gear acts directly on the cradle, which has trunnions pivoting in bearings on the under carriage (former slide). One end of the piston-rod of the hydraulic buffer is fixed to the breech of the gun, hence the buffer must act parallel to the direction of the recoiling gun. The whole revolves, balanced on the under-carriage, on anti-friction balls about a central pivot, which is contained in the pedestal fixed to the emplacement. The sights being placed on the cradle, the gunner who lays the gun is not disturbed by the recoil or the service of the gun. There is a shoulder-piece and sighting platform moving with the gun for the gun-layer, who unaided elevates, traverses, and fires about five rounds a minute — each shot weighing 100 lbs.

The 12-inch breech-loading Elswick battleship mounting, shown in Plate III., comprises the following principal parts: (1) turn-table traversed on an anti-friction roller ring by hydraulic or hand-gear acting on the training rack; (2) central ammunition trunk and hoists, which convey the shell and cartridges from the magazine below the water-line to the breech of the gun; (3) the slide-frame connected with the turn-table, upon which the gun in its cradle recoils. Two recoil presses or buffers are fixed at each side of the slide-frame, one end of each piston-rod being secured to the cradle. After recoil the reaction of the compressed springs returns the guns to firing position and keeps them there, which is very convenient when there is a rough sea. The gun in its cradle is elevated by the hydraulic elevating cylinder. The earlier naval mountings only admitted of loading in a certain fixed position, which delayed the service of the gun; the mounting above described admits of loading at any angle of training or elevation.

Plate I. shows on a wooden siege platform the firing carriage of the siege 6-inch breech-loading howitzer, which projects a 122-lb. steel shell containing 19 lbs. of lyddite. The carriage consists of two side brackets, a cradle with hydraulic buffers and running-out springs, elevating and traversing gear, brake gear, and an anchoring buffer, mounted on a steel hollow axle-tree with two wheels. The side plates are of double-plate steel construction, connected by top and bottom plates, transoms, a trail eye-plate, and front bracket which hold the trunnions of the cradle. The howitzer can recoil axially in the cradle, its longitudinal projections sliding in the corresponding grooves of the cradle. There are two cylindrical openings in the lower part of the cradle, each formed to take a hydraulic buffer fitted with powerful volute springs held in initial compression in order to retain the howitzer in its firing position. During recoil the springs are further compressed. The piston-rods of the buffers being fixed to the breech are always parallel to the axis of the howitzer. The interior of each buffer-tube is slightly tapered, so that the space round the periphery of the piston may form a varying orifice for the flow of the liquid, and consequently an approximately constant pressure is maintained throughout the stroke. A portion of the force of recoil being transmitted to the carriage itself, an anchoring buffer with volute springs is provided to connect the axle-tree to a pivot-plate on the platform; a fixed connection would soon destroy the latter. This buffer is so arranged that its piston is stationary, and its tube free to move with the carriage on recoil, after which the springs return the carriage to its former position. The carriage permits an elevation of 35°, which gives a range of 4900 yards and an angle of descent of 45°. When it is desired to fire over 35° up to 70° of elevation, that is, up to an extreme angle of descent of 60°, with a corresponding range of 8300 yards, the wheels are taken off, the carriage turned over, and a special top carriage fixed on, the whole structure being then similar to the old-fashioned mortar on its bed.

In the British field-gun carriage (fig. 2) there is a toothed spade suspended under the axle-tree by a telescope spring case. The blade of the spade is also attached by a wire rope to another spring case between the brackets When the gun is fired the teeth of the spade catch in the ground, the carriage moving over the spade, the wire-rope attachment drawing out the spring in the trail, and the shaft of the spade compressing the upright spring. After recoil the springs return the carriage to its former position. In favourable ground the spade acts very well. At the least it reduces the recoil, excessively long recoils exhausting the gunners who run up the guns. Plate II. shows a Krupp 75-millimetre (3-inch) gun on an experimental quick-firing field-carriage, with a trail brake which is fitted with a spring attached at one end to a trail spade, and at the other to a lever oscillating round a horizontal pivot passing through the side brackets. Axle-tree spade pivots have the advantage over trail ones of permitting the gun to be easily traversed. In the case of the Ehrhardt gun and carriage (Plate I.) the spade on recoil digs into the ground, the shock being absorbed by the gun-buffers and the spring in the hollow trail. After recoil the gun and carriage are forced back to the original position. The German wheels are smaller than the British pattern, which is advantageous in some respects.

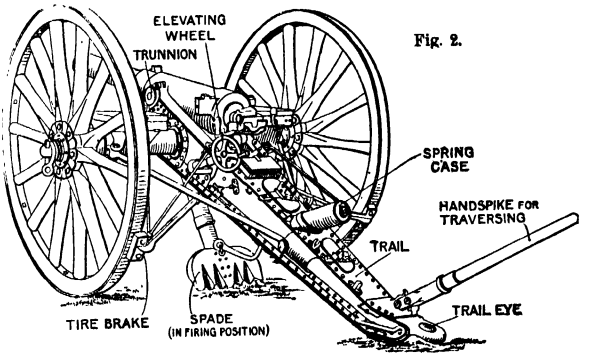


Fig. 2.

A field or siege carriage unites for travelling with a fore part, fixed on a pair of wheels, termed the *limber*. The attachment is by means of an eye at the end of the trail of the carriage fitting over an iron hook at the rear of the limber. The limber is fitted for pole or shaft draught, the whole forming a single four-wheeled carriage. The field limber has two boxes filled with ammunition fixed over the axle-tree frame, on which two gunners can sit. In the case of the 6-inch siege howitzer the total weight behind the team is about 4¼ tons. In that of a 15-pounder field-carriage it is about 40 cwts., which is the maximum weight capable of being manœuvred rapidly by a team of six horses. An increase in the number of horses does not correspondingly increase their total traction-power when at a rapid pace. The 15-pounder illustrates the incessant compromise in the field between mobility and gun-power. Conditions are always present when either may become the paramount consideration. Improvements in mechanical traction must lead to heavier guns accompanying mobile forces in the field. In the South African campaign of 1899–1901 the Boers were able with animal draught to make heavy guns exceedingly mobile. A galloping two-wheeled 15-pounder gun-carriage (the trail being the draught-pole) and 70-cwt. guns in the field are both possible events of the future.

In Major Moncrieff's first disappearing carriage, the gun on recoiling descended and raised a counter-weight. It was then loaded under the protection of the parapet, and on a pawl being released the counterweight descended, carrying the gun up into the firing position. The mechanical arrangements for lessening the sudden jerk and retaining the gun in loading and firing positions were soon disarranged. A disappearing carriage was then introduced with a hydro-pneumatic recoil cylinder, connected by valves with an outer chamber containing water, and air at a pressure of about 1350 lbs. per square inch. When the raising valve is opened the compressed air forces the water behind the ram, which being connected with the gun raises it. On firing, the descent of the recoil ram forces the water through the recoil valve back into the outer chamber. These mountings are now out of favour, owing to the leakage of the highly compressed air and the back pressures caused by the liberation of air absorbed by the liquid, &c. Disappearing guns are well suited for water-edge sites, but the increased ranges of modern guns enlarge the choice of suitable sites, which, for the purposes of security and greater fire area, are best on elevated ground.

In Plate II. is represented a 90-millimetre (3·54 inch) gun on a disappearing carriage, as designed by the French firm at Creusot. When made ready for firing, as in the upper figure, the whole system rests on the top surface of a cast-steel bolster D, and the wheels can turn freely round their axle; the connecting bolt between the piston-rod of the recoil buffer C and the oscillating arms is removed, and the spokes made to bear under the oscillating arms by means of a bar. The wheels are then turned by two winches, thus causing the arms to raise the gun, when the buffer is again fixed to the arms. The design of raising the gun by manual labour appears a novelty.

Plate II. also represents a Creusot carriage for firing a 155-mm. (6-inch) howitzer or short gun about 16 calibres long at high angles of elevation up to 60°, which would give an almost vertical descent to its projectiles. The chief characteristic is the combination of the hydraulic cylinders acting parallel to the direction of the guides of the oscillating slide with the vertical hydraulic buffer intended to absorb the downward blow. Spring recuperators ensure the rising of the slide and the return of the gun to their sliding position.

GUN-COTTON, or PYROXYLINE, is an explosive substance formed by the action of nitric acid on cotton. In the process of manufacture sulphuric acid is mixed with the nitric, in the proportion of 3 parts to 1 by weight. This sulphuric acid, great as is its quantity, does not act on the cotton directly in any way. Its function is to absorb the water formed by the weakening of the nitric acid as it gradually combines with the cotton. The product of this process is a chemical compound of about four times the explosive power of gunpowder, termed in chemistry tri-nitrocellulose. Theoretically the process of manufacture is extremely simple. Practically a number of washings and other operations are necessary to free the product of all acid. Sir F. Abel, when chemist of the war department, invented and brought in a pulping process, by which cotton can be more thoroughly cleaned than could be effected with any less complete disintegration. It also admits of the mixture of nitrates with it. By an admixture of 40 parts nitre to 100 gun-cotton, a

much cheaper and more serviceable substance is obtained than ordinary gun-cotton, either in skein or pulp cake. When gun-cotton first came in its recommendations of convenience, cleanliness, and great explosive power, and, above all, absence of smoke, seemed to promise for it a more extensive adoption than it has yet met with. The explosion is more complete than that of gunpowder, but it is difficult to control; and when confined, as in the bore of a rifle, it occasionally bursts the barrel, while, as a bursting charge for shells, it has the disadvantage of being liable to explode on the shock given by the discharge of the gun. If ignited under ordinary conditions in the open air, or even in the confinement of a slight building, it only flares; when fired in a gun or shell it violently explodes. The fact that really discouraged its advocates was the liability that it had to explode spontaneously in store, when not quite pure, chemical action being set up by the presence of an acid, or by the less stable compounds formed by an incomplete process of chemical combination in manufacture. Baron Lenk in Austria, Sir F. Abel, and most of the great private manufacturers, both in Britain and elsewhere, have had to experience the occurrence of an explosion in a store of gun-cotton. The great danger attending the manufacture and storage of these nitro-compounds led in Britain to the passing of the Explosives Act of 1875, by which the manufacture, carriage, and sale of high explosives are regulated, and the result of an accidental explosion is minimized by the precautions enforced. Although these accidents may have been since traced to their true cause, they were not expected beforehand, and could not fail to shake the public faith in gun-cotton. However, gun cotton has come into use for various purposes, as in torpedoes and submarine mines, several kinds of gunpowder, &c., one or two discoveries having led to improvements of a radical character. Of these the first was the fact arrived at by Mr. Brown of the Royal Arsenal, when carrying on investigations under Sir Frederick Abel, that a sudden explosion of a peculiar nature might be generated by the application of a powerful detonator instead of the ordinary means of ignition. So sudden and violent is this action, that a wall may be blown down by means of insignificant gun-cotton disks laid on the ground in the open air against the base of the wall, and stockades may be cut through by hanging small gun-cotton necklaces on them. The still stranger discovery was afterwards made by Mr. Brown, that the presence of water and other substances did not interfere with this kind of explosion. It seems probable that the vibration of the explosion generated by the firing of gun-cotton by detonation is of such a character that water is not susceptible to its influence. Thus, while water takes up and absorbs the vibrations of ordinary heat, its presence does not interfere with the wave, as it were, of detonating explosion, but allows it to pass through it unimpeded in a manner analogous to that in which glass, from its want of susceptibility to the waves of light, allows them to pass through it, or, in other words, is transparent. From this property in the detonating action of gun-cotton follows the important fact that it can be kept wet with safety while in a condition in which it may be exploded by means of a detonator. *In short, when wet it is quite safe, and yet quite ready for work at a moment's notice*; for, while it refuses to burn even in the heat of a powerful flame, the application of a large detonator or of a small detonator inserted in one dry disk of gun-cotton causes the wet mass to explode with its full violence. Nitro-cellulose is the base of all modern smokeless explosives, and when chemically pure it is safe to store. A modified compound of the same kind is known commercially as celluloid (which see). An imperfect chemical form of gun-cotton termed collodion, soluble in a mixture of ether and alcohol, is used in photography.

GUNNER, in the navy, is a warrant-officer appointed to take charge of the ammunition and ordnance of a war-vessel, and to have a general supervision of the weapons. There are also *chief-gunners*, who are commissioned officers; *gunners'-mates*, who are petty officers; and *seamen-gunners*. A gunner in the artillery corresponds to a private in the line. There are also warrant-officers of artillery known as *master-gunners*.

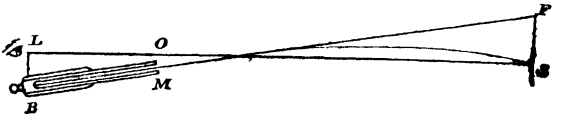
GUNNERY in one important sense signifies the art of conducting the fire of artillery on land or on board ship. Any science exercised in the construction of guns, carriages, and ammunition, any talent in organization and tactics, is thrown away, if the guns are not laid correctly on the target. The celebrated advance at Friedland by General Senarmont of 36 guns to case-shot range was a correct application of tactics based on a knowledge of this art; the capture of the Chesapeake by the Shannon (see BROKE), attributed wholly to superior gunnery, gives an instance on the sea. In a wider sense it includes the subjects discussed under GUNS.

The principal definitions of important terms used in gunnery are as follows. The *energy* of the projectile is the work stored up in it at the moment considered. It equals $\frac{WV^2}{2g} \div 2240$ foot-tons: where W is the weight of the projectile in lbs., V its velocity in feet per second, g a constant expressing the force of gravity = 32·2. As the square of the velocity appears in this expression, we can easily see that an increase of velocity has more effect on energy than an increase of weight. For instance, the 12-inch breech-loader shell, with a muzzle velocity of 1914 feet per second, has a muzzle energy of 18,137 foot-tons; but the 12-inch rifled muzzle-loader shell of nearly the same weight, with a muzzle velocity of 1390 feet per second, has a muzzle energy of only 9563 foot-tons. In other words, to get the same energy as the breech-loader shell, the rifled muzzle-loader shell must increase either its velocity nearly by one-third or its weight by double.

The *calibre* of a gun is the diameter of the bore measured in inches. It is a convenient unit in the comparison of guns, considering them as mechanical models of one another. Thus, the Lee-Metford rifle of ·303 inch in calibre has a bore 66 calibres (30·2 inches) long; the rifling makes one complete twist in 33 calibres (1 in 10 inches); and the bullet is 4 calibres (1·25 inch) long. Again, the wire 9·2-inch breech-loading gun, 27 tons in weight, has a bore about 47 calibres (429 inches) long, its twist is 1 in 30 calibres at the muzzle, and its shell is 3½ calibres long.

Direct fire is from guns at angles of elevation less than 15°. *Curved* fire is from howitzers at angles of less than 50°. *High-angle* fire is from guns and howitzers at more than 15°. In the naval service these terms are applied rather differently. The *trajectory* is the curve described by the projectile in passing from the muzzle to the first point of impact. It is curved, since although the force of the powder propels the projectile in a straight line, yet immediately on leaving the bore the force of the earth's gravity begins to drag it down. The trajectory is more curved with a low-velocity gun than with a high velocity one, because the low-velocity projectile passes over any horizontal space more slowly, and

gravity has more time to act upon it than upon a quicker projectile. Hence to obtain the same range the lower-velocity gun must have a greater angle of elevation above the horizontal plane. To allow for the fall of the projectile, it is necessary to point the axis of the bore of the gun as much above the mark as the projectile would have fallen below if the axis had been pointed straight on the mark. Hence heavy guns are provided with a 'tangent scale' L B (see accompanying fig.) at the breech, and a fore-sight O at the chase of the gun; the fore-sight being made high enough so that the gun itself does not interfere with the aim. Small-arms are all similarly provided with sights. The figure shows the principle of sighting. The *line of sight* is the visual ray passing through L the top of the tangent scale, O the top of the fore-sight, and S the target; M F shows the direction of axis of bore. On the tangent scale or sight are marked the elevations necessary for successive hundreds of yards. The tangent scale is put up and down in its socket to suit the range. Different natures of guns naturally require different elevations. The elevations for new guns are calculated theoretically for all ranges: then the calculations are tested by actually firing some rounds at a few elevations, which give data for correcting, if necessary, the elevations for the intervening ranges. Laying of guns by the line of sight is called *direct* laying. An *indirect* way of putting on the angle of elevation for a range is by means of a spirit-level. This is the usual method with howitzers, which generally fire from behind and over cover at unseen targets. Another indirect way, much used in coast forts, where the mountings are fixed, is to mark on the carriages the elevations, so that an index on the gun is elevated or depressed to the corresponding marks.



It follows that to hit a target its range must be found. This is done by an instrument known as a *range-finder*. The principle of the range-finder is that of measuring the angle subtended at the target by a known base. In coast forts, the Watkins depression range-finder, put on a known height above the sea-level, measures ranges from itself to the ship. The telescope forming part of the instrument is kept aligned on the moving ship by turning two screws, the one revolving the axis horizontally and the other vertically. The latter screw is graduated spirally in yards, and by means of a fixed index the range of a target is read off the scale. The Watkins vertical base position-finder is on the same principle. It is generally placed a considerable distance from the guns. Primarily it takes the range from the instrument to the ship, but by an automatic arrangement this range is corrected to that from the guns to the ship. The corrected range is transmitted by electric dials to the guns. In 'auto-sights' the telescope is so attached to the gun by link and cam work, that in elevating or depressing the gun in order to align the telescope on the ship, the gun adjusts itself to the correct range. These sights are now much used for coast service. When the coast is flat or the guns are in the field, it is necessary to have horizontal base instruments, which are difficult to manage. Field artillery prefer to fire a shell at once. If it falls short of the target, the range of the gun is increased so as to get an over, or vice versa. Then a third shell is fired at an intermediate range, and so on, till the correct range is arrived at. The obscuring of the target by the smoke of the bursting shell indicates that the round has fallen short. In the navy Barr and Stroud's instrument is sometimes used, the images of objects being made to coincide by turning reflecting prisms. Its base is only 4½ feet. This type of range-finder has the advantage of not requiring a level platform.

GUNNY-BAGS are bags made of a coarse cloth or sacking manufactured in India of some native fibre, chiefly jute. They are extensively used in India in packing rice, sago, spices, &c., for export, and are themselves largely exported. Such bags are also made of jute in Dundee.

GUNPOWDER, essentially a solid compound of carbon, hydrogen, oxygen, and nitrogen, the two latter being feebly combined. On explosion the nitrogen readily parts with its oxygen to the carbon and hydrogen, highly-heated gaseous carbonic acid, carbonic oxide, free nitrogen and steam, and some more or less solid residue being formed. The rapid conversion of gunpowder into gases, at a high temperature, occupying many times the volume of the original solid form, furnishes energy to propel projectiles from guns. In ordinary black gunpowder the nitrogen and oxygen is contained in the saltpetre (KNO_3), the charcoal furnishes the carbon, and the sulphur facilitates ignition. The early history of charcoal gunpowder is obscure. The Chinese at a remote period seem to have used it in fireworks, and the famous Greek-fire employed by the Byzantines in the seventh century is supposed to have been similar in its composition. The invention of gunpowder for use in guns is probably European. Roger Bacon knew the ingredients of gunpowder in the thirteenth century. The German Schwartz in 1320 improved its manufacture. The English are said to have used it against the Scotch in 1327, and they had three cannon at Crecy in 1346. (See CANNON.) At the end of the sixteenth century the famous Waltham Abbey gunpowder factory was privately started: in 1787 the government bought the factory, and still carries it on, having latterly erected new works for the manufacture of cordite, including its ingredients. At Waltham Abbey the ingredients of the black gunpowder made are 75 parts saltpetre, 15 charcoal, and 10 sulphur. The *grough* or crude saltpetre is refined by cooling its hot solution from 212° F. to 70° F., when about six-sevenths of pure saltpetre is deposited solid at the bottom, whereas the foreign salts, being as soluble in cold water as in hot, remain in the liquor. The charcoal is obtained by distilling alder, willow, or dogwood in an iron cylinder at a temperature of 800° F. This process drives off the liquid and more volatile constituents, which otherwise during the explosion would absorb an undue amount of the heat. The sulphur combines readily with the oxygen at the moderate temperature of 560° F., this initial combustion increases the temperature rapidly, and the oxygen and carbon then combine explosively. About one-half by weight of the products of explosion are solid, which, mingled with the gaseous, produce the characteristic smoke. The ingredients of charcoal gunpowder are incorporated in a moist state under rollers in a mill. The resulting 'mill-cake' is then reduced in the 'breaking-down machine' to meal, which is pressed between the metal plates of the hydraulic press-box to form 'press-cake'. This 'press-cake' is made into 'grain' on passing between the toothed rollers of the granulating

machine. The grains are separated into various sizes by being sifted through the meshes of screens, then dusted, glazed by friction in revolving churns, and finally dried in a stove. Since the introduction of charcoal gunpowder into Europe its ingredients have remained the same, although the proportions have varied somewhat at different times and in different countries. About 1880 the British Explosives Committee initiated experiments, which were considered to demonstrate that variations in the manufacture of gunpowder excited more influence in its action than a considerable difference in composition. This conclusion was soon disturbed by the introduction from the Continent of slow-burning brown prismatic powders, containing 79 parts saltpetre, 18 charcoal made from rye-straw, and 3 parts sulphur, from 1·7 to 2·2 per cent of water being present as an ingredient. The best powder for naval and military purposes is that which evolves gas in proportion as the space in the bore of the gun increases by the passage of the shot. For some centuries gunpowder remained in the form of dust or 'meal'. In this form it ignites slowly, as the minute interstices do not permit the flame to pass, whilst its bulk for a given weight takes up an undue amount of space; its consequent slow combustion accounts for the great length of some old guns. The invention of granulated or 'corned' powder formed an epoch in the use of fire-arms. It was first used in small-arms; however, in Elizabeth's reign it was introduced for cannons. 'Grained' powders allow a more rapid ignition, but their pressure violently reaches the maximum before the projectile has time to move far down the bore, and then it decreases rapidly. Hence guns became very short, thick at the breech, and tapered rapidly towards the muzzle. To obtain modern velocities enormous charges of grained powders would be necessary. The so-called 'pebble' powder was introduced in order to lower the maximum pressure by a slower combustion of a larger grain. It is formed by cutting the press-cake into small cubes, whose edges are rounded off by the friction of the glazing process. Then followed a larger pebble powder, technically marked as P^a. Subsequently mealed or small-grained powder was pressed into the form of prisms, about $1'' \times 1{\cdot}38''$ in measurement, with a hole in the centre to preserve uniformity of ignition and combustion—the so-called 'prismatic powder'. In order to take full advantage of these slow-burning powders, the bores of guns were continually increased, since short guns blew out a portion of the grains unconsumed. Moreover, these new powders, giving higher pressure towards the muzzle, necessitated increased forward strength, some of the first made breech-loading guns of modern type having blown off their hooped chases. These developments were accentuated by the introduction of smokeless powders.

In smokeless gunpowders the whole of the constituents become invisible gas, giving out a most vivid flash. Generally speaking, they are made by gelatinizing gun-cotton in a solvent such as acetone, by which treatment its fibrous character is changed to the appearance of horn. Mr. Alfred Nobel, starting from his previous invention of blasting gelatine, composed of 94 per cent nitro-glycerine, absorbed by 6 per cent soluble gun-cotton, when kneaded under the influence of heat, made the discovery that with 60 per cent and 40 per cent respectively, incorporated and gelatinized between hot rollers, a new compound (ballistite) was formed, which burnt comparatively slowly and quietly in guns, and which is perfectly safe in ordinary handling. The British War-office chemists, dissolving insoluble gun-cotton in acetone, were able to incorporate and gelatinize it with nitro-glycerine by a process of kneading in a dough machine. This mixture is called 'cordite', from being pressed through dies into the form of cords. In the same way as the size of the grains of charcoal gunpowder is made to suit the gun, so cordite is made of various diameters. Cordite is in appearance like yellowish gutta-percha. It consists of 58 per cent nitro-glycerine, 37 per cent gun-cotton, and 5 per cent vaseline, which is added to make the cordite flexible and reduce friction in the incorporating process, while it also counteracts metallic fouling in small-arms. The acetone is finally driven off in the drying process. The cordite is wound on reels, and afterwards cut up in lengths suitable for the various cartridges. Cordite is of the nature of a physical mixture; under the microscope a film shows minute patches of nitro-glycerine gripped by the cellular structure of the gun-cotton. It is more influenced by heat than charcoal gunpowder, so that its pressure and velocity in a gun depend in some small measure on the temperature of the day. Exhaustive experiments show that its keeping qualities are excellent in the extremes of climatic heat and cold. Wet cordite can be fired; moisture does not deteriorate it. Being difficult to ignite, an 'igniter' of black gunpowder is put in the cartridge to extend the flash of the firing-tube. In the open air cordite burns quietly without explosion. In May, 1894, at Waltham Abbey, 3700 lbs. of nitro-glycerine exploded accidentally, and a stove, only 85 yards away, in which 3000 lbs. of cordite was being dried, was completely wrecked, but none of the cordite ignited.

A gun-barrel eroded by charcoal gunpowder resembles the rough bark of a tree. With cordite the surface appears as if washed away by the flow of highly-heated gases. Captain Noble thinks that cordite is not more erosive than brown charcoal gunpowder, if the greater energy of the cordite for a given weight is taken into consideration. He concludes that heat is the principal factor in determining the amount of erosion; it is evidently a factor in the amount of the energy developed on explosion. In his experiments samples of cordite containing from 10 to 60 per cent of nitro-glycerine were used. The greater proportions of nitro-glycerine gave greater heat, but a less volume of gas, which also is a factor of the energy. The problem is how to decrease the heat without decreasing the energy. The French B.N. (*blanche nouvelle*, 'new white') powder consists of nitro-cellulose, partly gelatinized and mixed with tannin and with barium and potassium nitrates.

Each description of gunpowder is proved for pressure and muzzle velocity in a gun of the same nature for which it will be used, one or more rounds of a standard batch of gunpowder, kept for that purpose, being fired at the same time to get a comparison for checking results.

The invention of gunpowder must be regarded as one of the most important events in the world's history, and one which has, on the whole, made for the progress of mankind to higher civilization. That we know neither the date of its first invention nor the name of the man who first made it, is but one of the many facts which show that no inconsiderable part of the world's progress cannot be associated with particular individuals or definite historic epochs, but is to be regarded rather as the work of the gradually unfolding collective mind of humanity. The influence of gunpowder in making for the ultimate peace of the world has been incalculable.

GUNPOWDER, LAWS RELATING TO. The manufacture and sale of gunpowder have from the time of

Charles I. been regulated by law. The law which now regulates the manufacture, storage, sale, and conveyance of gunpowder and other explosives is set forth in the Explosives Act 38 and 39 Vict. cap. xvii. (1875). Explosives are therein defined to be gunpowder, nitro-glycerine, dynamite, gun-cotton, fulminate of mercury, coloured fires, and every other substance used or made to produce a practical effect by explosion or a pyrotechnical effect. Gunpowder shall not be made except at a factory lawfully existing or licensed under this act, unless in small quantities for experiment and not for practical use or sale. Gunpowder, except for private use and not for sale to the extent of 30 lbs. on the same premises, or for the purpose of conveyance, to be kept only in the factory or in a magazine or store either lawfully existing or licensed under this act or in premises registered for this purpose. New factories or magazines shall be established only under the license of the secretary of state with the assent of the local authority. The occupier of every factory, magazine, or store must take all due precautions to prevent accidents by fire or explosion, also to prevent access of all unauthorized persons. Orders in council may be made to regulate details of construction and situation of gunpowder stores; also the maximum quantity, not exceeding two tons, to be stored therein. Gunpowder shall not be hawked, sold, or exposed for sale upon any highway, street, public thoroughfare, or public place, under a penalty not exceeding 40*s.* and forfeiture of the gunpowder. It shall not be sold to any child apparently under the age of 13 years, under a penalty not exceeding £5. It must not be sold in any quantity over 1 lb. in weight unless in a substantial case, bag, canister, or other receptacle, made and closed so as to prevent escape of the contents, and marked 'gunpowder'. By-laws are to be made by harbour authorities, railway and canal companies, and the occupiers of wharves and docks for the conveyance, loading, and unloading of gunpowder, such by-laws to be sanctioned by the secretary of state. Any government inspector, or constable, or officer of a local authority, having reason to believe that any offence has been or is being committed with respect to an explosive in any place, may at any time enter the same, if needs be, by force; obstruction will incur penalty not exceeding £50, with forfeiture of the substance. In April, 1883, in consequence of the outrages committed and threatened by the members of Irish secret societies, the government passed a bill to amend the above act. Premising that wilful explosions causing the loss of life would come under the law of murder, the bill enacts that an explosion which does not cause death will be felony, punishable with penal servitude for life; an attempt to cause an explosion is also considered as a felony, with a penalty of 20 years' penal servitude. Any person found with an explosive substance in his possession or in his control under a reasonable suspicion that it is for an unlawful purpose, or if he cannot explain that it was for lawful purposes, will be liable to 14 years' penal servitude. Any person aiding in the commission of any crime under this act, shall be treated as a principal; and the magistrates are empowered to hold an inquiry even when no one is in custody. Merchant captains are empowered to break open packages which they suspect to contain dangerous matters. All materials for explosives and machinery for exploding them are included.

GUNPOWDER PLOT, a conspiracy formed in 1604, the second year of the reign of James I., by some Catholic fanatics to blow up the king and Parliament. The time ultimately fixed for the execution of the plot, which had been twice postponed on account of the prorogation of Parliament, was the expected meeting of that body on the 5th of November, 1605, when it was to be opened by the king in person. The principal conspirators were Robert Catesby, son of Sir William Catesby, and of a sister of Thomas Throgmorton, who had both become converts to Catholicism; Thomas Winter, of a Roman Catholic family connected by marriage with the Catesbys, who had joined in the insurrection of Essex and other plots, and been fined in £3000; and John Wright, another Catholic convert and insurgent with Essex. The plot originated with these three, and was at once communicated to Guido Fawkes, the son of a notary, a zealous Catholic, who had served in the Spanish army in Flanders, and had come to London with Thomas Winter in 1604, and to Thomas Percy, a relation of the Earl of Northumberland. These five were the original conspirators, and on the communication of the plot to the last two they swore secrecy, and took the sacrament together. It was subsequently communicated to Sir Everard Digby, Ambrose Rookwood, and Francis Tresham, the two former young men under the influence of the Jesuits and priests; to Thomas Keyes, a man who was hired to take charge of a house at Lambeth, which the conspirators had hired to store their powder and faggots; to Christopher Wright, a brother of John, and to some Jesuit fathers and others. The conspirators took a house next the Parliament House, for which there is a signed agreement among the state papers, dated May 24, 1604. Their plan was by digging under this house to undermine the House of Parliament. For various reasons the work was delayed till within a fortnight of Christmas. Fawkes acted as sentinel, and the other four original conspirators, joined ultimately by Christopher Wright and Keyes, dug at the mine. The labour was arduous, as they were all gentlemen unaccustomed to such toil, and they had to dig through a stone wall 18 feet deep. While they were working at their mine in February, 1605, they heard a noise above their heads, which Fawkes on investigation found to have proceeded from a cellar right under the chamber of Parliament, which was occupied by a coal dealer. They at once hired this cellar, and filled it with powder, faggots, and billets. In May, when their stores were all collected, they locked the cellar, and left London.

In the discovery of the plot there are some circumstances not very easily explained, and on which various interpretations have been put. Lord Mounteagle, a Catholic peer in favour with the court, had a house at Hoxton, which appears not to have been at this time his ordinary residence. Going thither on 26th October to supper, about 7 o'clock in the evening a letter was handed in, which he caused to be read aloud before his attendants, and then proceeded to lay it before the secretary of state, Cecil. It was a warning couched in mysterious terms, not to be present at the approaching meeting of Parliament. Cecil, whom no one would suspect of want of vigilance or acuteness, appeared to make light of it. He showed it to some of the council, affected scepticism as to its threats, and did nothing till the return of the king, six days after, from a hunting party. On hearing the letter, which had so puzzled his council, James at once divined its meaning. By a divine illumination of his mind, as Coke says, he read it as referring to an explosion of gunpowder. On 4th November the lord chamberlain went to the House of Lords, and afterwards visited the vaults under the Parliament Chamber, which he found in charge of 'a very tall and desperate fellow'. He asked this fellow (Fawkes) to whom the large accumulation of fuel he saw there belonged, and was answered that it was to his master Mr. Percy. A Westminster magistrate made a general examination during the day of the neighbour-

ing houses and cellars, and a little before midnight the same magistrate proceeded to the cellar with a strong body of attendants, and arrested Fawkes, who was just leaving. On removing the billets a hogshead and thirty-six barrels of powder were discovered.

The letter addressed to Lord Mounteagle reads very naturally, and is couched just in such terms as we would expect such a warning to be. The repeated injunctions not to slight the warning, 'thinke not slightly of this advertisement,' 'this counсel is not to be contemned,' and 'i hope god will give yowe the grace to mak good use of it,' have an air of earnestness not very easily assumed. Another curious indication of genuineness or skilful simulation, is that after the words, 'out of the love I bear,' the writer has deleted 'you,' and substituted 'to some of youere friendz.' It has, however, been generally agreed that the visit of Mounteagle to Hoxton, the reception, and the reading aloud of the letter were a piece of acting. The letter is supposed to have been written by Tresham, Mounteagle's brother-in-law. Mounteagle is supposed to have been fully informed by Tresham of the whole plot, and the sending and publication of the letter were apparently designed both to screen Tresham as its betrayer, and to give his associates an opportunity to escape. Whether the visit to the secretary was a part of the play is not so well made out. Mounteagle's warning does not seem to have been the first intimation the government had of the plot, yet if they were in possession of fuller information their conduct seems unaccountable. The inaction of the secretary has not in any case been satisfactorily explained. It can hardly be imagined that he was anxious for the escape of the prisoners; yet if he had been he could have taken no course more likely to promote his object than that he took. It seems almost ridiculous to suggest that Cecil, knowing the king's vanity, sacrificed every other consideration to that of making him the discoverer of the plot; but no other explanation appears to fit the facts so well.

Fawkes, as is well known, was subjected to torture. Of the other conspirators six left London on the 4th and 5th. Five of them proceeded to Dunchurch, where they found a large assemblage of Catholics, who had been brought together by vague intimations of some mysterious event. The aspect and communications of the conspirators soon dispersed the bulk of these associates, yet they determined to defend themselves. Catesby, Percy, and the two Wrights were killed in defending Holbeach House, in which they had taken refuge, against the sheriff. Sir Everard Digby was tried and executed at Northampton, Tresham died in prison. Fawkes, Rookwood, Winter, and others were tried at Westminster on 27th Jan., 1606, and executed on the 30th and 31st. The Jesuits, Garnett and Oldcorne, soon afterwards suffered. See Jardine's Narrative of the Gunpowder Plot (1857), and the histories of Lingard, Gardiner, &c. Recently Father Gerard in his What was the Gunpowder Plot? has tried to show that it was an invention of the enemies of the Roman Catholics; a reply being Gardiner's What the Gunpowder Plot was (1897).

GÜNS, or **Kőszegh**, a town, Hungary, capital of the county of Eisenburg, on a slope above a stream of same name, 57 miles S.E. of Vienna, and at nearly the same distance from Pressburg, Raab, and Grätz. It consists of a walled town of limited extent, and a large suburb, and has a very handsome old castle, a Piarist college and gymnasium, and a Benedictine monastery. Its staple manufacture is woollen cloth, largely exported to Croatia and Slavonia; and it has a considerable trade in wine and fruit, particularly cherries of remarkable size and flavour. The citizens of Güns, aided by a small garrison of 800 men, gained great renown by their successful defence against a powerful Turkish host, headed by Sultan Solyman the Magnificent. Pop. (1890), 7076.

GUNTER, Edmund, an excellent English mathematician, who flourished in the reign of James I., and distinguished himself by his inventions, which have never yet been superseded, though some of them have been subsequently much improved. He was born in Hertfordshire in 1581, and died in 1626. He was educated at Oxford, and became professor of astronomy in Gresham College, London, in 1619. See the next three articles.

GUNTER'S CHAIN, the chain in common use for measuring land according to the true or statute measure; so called from the name of its inventor, Edmund Gunter. The length of the chain is 66 feet, or 22 yards, or 4 poles of 5½ yards each; and it is divided into 100 links of 7·92 inches each. 100,000 square links make 1 acre.

GUNTER'S QUADRANT is a quadrant made of wood, brass, or some other substance; being a kind of stereographic projection on the plane of the equinoctial, the eye being supposed in one of the poles; so that the tropic, ecliptic, and horizon form the arcs of circles; but the hour circles are other curves, drawn by means of several altitudes of the sun for some particular latitude every year. This instrument is used to find the hour of the day, the sun's azimuth, &c., and other common problems of the sphere or globe; as also to take the altitude of an object in degrees.

GUNTER'S SCALE, usually called by seamen the *gunter*, is a large plain scale having various lines upon it, of great use in working the cases or problems in navigation. This scale is usually 2 feet long and about 1½ inch broad, with various lines upon it, both natural and logarithmic, relating to trigonometry, navigation, &c. On the one side are the natural lines, and on the other the artificial or logarithmic ones. The former side is first divided into inches and tenths, and numbered from 1 to 24 inches, running the whole length near one edge. One-half of the length of this side consists of two plane diagonal scales for taking off dimensions for three places of figures. On the other half of this side are contained various lines relating to trigonometry, as performed by natural numbers, and marked thus, namely—*Rhumb*, the rhumbs or points of the compass; *Chord*, the line of chords; *Sine*, the line of sines; *Tang.*, the tangents; *S. T.*, the semi-tangents; and at the other end of this half are *Leag.*, leagues or equal parts; *Rhumb*, another line of rhumbs; *M. L.*, miles of longitude; *Chor.*, another line of chords. Also, in the middle of the foot are *L.* and *P.*, two other lines of equal parts; and all these lines on this side of the scale serve for drawing or laying down the figures to the cases in trigonometry and navigation. On the other side of the scale are the following artificial or logarithmic lines, which serve for working or resolving those cases, namely—*S. R.*, the sine rhumbs; *T. R.*, the tangent rhumbs; *Numb.*, line of numbers; *Sine*, sines; *V. S.*, versed sines; *Tang.*, the tangents; *Mer.*, meridional parts; *E. P.*, equal parts.

GUNTUR, a town of Hindustan, presidency of Madras, district of Kistna, 150 miles E.S.E. of Haidarabad, and 30 miles from the Coromandel coast. It consists of an old and new town, has been much improved of late, and is healthy. Pop. (1901), 30,833.

GUNWALE, or **Gunnel of a Ship**, is that piece of timber which reaches on either side of the ship from the half-deck to the forecastle, being the uppermost bend, which finishes the upper works of the hull in that part, and wherein they put the stanchions which support the waist-trees. This is called the *gunwale*, whether there be guns in the ship or

not. The upper edge of the side of a boat is also termed the gunwale.

GURHWAL, Gurwal, or Garhwal, a district of the Indian Empire, in the United Provinces, bounded on the north by Tibet, on the east by Kumaon district, on the south by Bijnor district, and on the west by the native state of Gurhwal, or Tehri, and Dehra Doon district; area, about 5500 square miles. Gurhwal district consists almost entirely of rugged mountain ranges intersected by narrow valleys and gorges, the broadest, that of Srinagar, being barely half-a-mile in width. Only a small portion of the country is either inhabited or cultivated. In this and the adjoining division of Kumaon some of the loftiest peaks of the Himalayas occur. These are not found on a continuous ridge, but are grouped together in masses that are separated from one another by deep depressions, through which flow the streams that drain those parts of the mountains immediately contiguous to the north. Five or six of these peaks are above 24,000 feet high, and the number that exceeds 20,000 feet is very great. They are covered with perpetual snow, and present an inconceivably magnificent appearance, especially in November and December, when the perfect serenity of the autumnal air displays the splendid lights and shadows thrown by the setting sun on the wonderful scene. Glaciers also abound amongst them, some of which are of great magnitude. The climate in this elevated region is extremely various, passing from the intense heat of the plains of Hindustan to the rigours of an unceasing winter. The rainy months are June, July, August, and the first half of September. The vegetation of Gurhwal, and of the entire region to which it belongs, is of course influenced by altitude. The larger trees are almost entirely restricted to the plains and more level valleys. Tropical vegetation prevails to a height of about 4000 feet, and in the deep sheltered ravines is carried into the heart of the mountains. In the outer part of the latter one of the great features of the landscape is the *Pinus longifolia*, which clothes the slopes of almost every hill. Above the height of 4000 feet oaks and rhododendrons gradually increase in number. In the upper forest region the trees are oaks, pines, yew, elm, horse-chestnut, walnut, several maples, hazel, &c. These again cease rather suddenly at an elevation of 11,500 feet, and are succeeded by shrubs, including the mountain-ash, rose, barberry, lilac, willow, juniper, &c. Higher up a most luxuriant herbaceous vegetation prevails. In this and the adjoining province of Kumaon and others the tea-plant has been cultivated with great success, flourishing even in situations where it is occasionally covered with snow. The population of Gurhwal and of the adjoining province of Kumaon mainly consists of Hindus; the most important tribe being the Khasiyans, who constitute about nine-tenths of the whole. They are a strictly agricultural people, speaking a Hindu dialect. Pop. (1901), 429,892.—The native state of Gurhwal has an area of 4180 square miles; pop. (1901), 267,608. It is governed by a rajah under British control.

GURNARD (*Trigla*, Linn.), a genus of sea fishes, all of which afford excellent food. They have a scaly body, of a uniform shape, compressed laterally, and attenuated towards the tail. The head is broader than the body, and slopes towards the snout; the upper jaw extends beyond the lower. The eyes are near the top of the head, large and prominent, particularly the upper margin of the orbits. The dorsal fins are unequal, the first short, high, and aculeate; the second long, and sloping. The ventral and pectoral are uncommonly large, and from the base of the latter hang three loose and slender appendages. Many of the species utter a peculiar noise when taken; some of the species are provided with pectoral fins sufficiently large to enable them to spring out of the water. One of the species has been denominated the *lyre fish*, on account of its bifurcated rostrum, which bears a faint resemblance to that instrument. The large size of the suborbital bones giving a hard covering to the cheek, has procured the name *Sclerogenidæ* for the family to which these fishes belong.

The British species are the Red or Cuckoo Gurnard, *T. cuculus;* the Streaked Gurnard, *T. lineata;* the Sapphirine Gurnard, *T. hirundo;* the Little Gurnard, *T. poecilоptera;* the Piper, *T. lyra;* the Gray Gurnard, *T. gurnardus;* Bloch's Gurnard, *T. Blochii;* and the Long-finned Captain, *T. lucerna*. The Mailed Gurnard, with its fantastic bony plates on head and body, belongs to the genus *Peristedion*, which is without teeth.

GURNEY, Joseph John, was the tenth child of John Gurney, Esq., of Earlham Hall, near Norwich, and born there on 2d August, 1788. He was educated at Oxford, where he made considerable proficiency in the ancient languages and in mathematics. On leaving college he became a member of the banking firm of which his father was a founder, and took an active share in its management. In 1818 he became a preacher in the Society of Friends, of which he had been brought up a member; and the same year accompanied his sister, Mrs. Fry, on her tour to Scotland, having been induced to espouse warmly the benevolent cause to which she had devoted herself—the amelioration of the condition of prisoners. In 1827 the two made a journey to Ireland with the same object, and in 1837 Mr. Gurney visited the United States and British North America, where he was absent for nearly three years. He had scarcely returned home when he set out with Mrs. Fry in 1841 for the Continent, visiting Holland, Belgium, and Germany, and subsequently, in 1842–44, visited France and Switzerland. The object of these journeys was the amelioration of prison management, and also to endeavour to effect the abolition of slavery in the French colonies, for which purpose he had interviews with Louis Philippe and M. Guizot. Mr. Gurney died at Earlham Hall on 4th January, 1847. He was the author of several works, among which may be mentioned Notes on Prisons and Prison Discipline (London, 1819); Observations on the Religious Peculiarities of the Society of Friends (1824); and Essays on the Evidences, Doctrines, and Practical Operation of Christianity (1827). He took an active part in promoting all philanthropic efforts, such as the abolition of slavery and the peace and temperance causes, and was at all times liberal with his purse in alleviating distress, whether public or private.

GURWOOD, John, editor of the Wellington Despatches, was born in 1791, entered the British army as ensign in 1808, and accompanied his regiment to the Peninsula. Having volunteered to lead the forlorn hope at the storming of Ciudad Rodrigo on 19th January, 1812, his offer was accepted, and he succeeded in carrying through his enterprise, and taking prisoner the French governor of the town. This act of gallantry brought him into notice, and in process of time he rose to the rank of colonel. In 1830 he became private secretary to the Duke of Wellington, an appointment which led to the publication by him of the duke's despatches, during his campaigns in various parts of the world, from 1799 to 1818. This work, comprising thirteen volumes, published in 1834–39, became immensely popular. A second edition with additions appeared in 1844. The General Orders of the Duke from 1809 to 1818, compiled by Gurwood, were published in 1837. The

Duke's Speeches in Parliament, arranged by Colonel Gurwood, were published in 1853. Colonel Gurwood was appointed by the duke deputy-governor of the Tower of London. He committed suicide in a fit of temporary insanity at Brighton, on 25th December, 1845.

GUSTAVIA, a town, West Indies, capital of the French island of St. Bartholomew, on its south-west coast. It has a safe and well-protected harbour, and a castle. See BARTHOLOMEW (ST.)

GUSTAVUS I., commonly called *Gustavus Vasa*, King of Sweden from 1523 to 1560, and deliverer of his country, was born, according to recent authorities, at Lindholmen, in Upland, on May 12, 1496. He was the son of Eric Johansson, a Swedish senator and governor of Aland, from whom he derived the surname of Ericsson. Both his parents are said to have been descended from the ancient kings of Sweden. He studied at the University of Upsala, and entered the service of Sten Sture the younger, administrator of the kingdom in 1514. Sweden had, by the union of Calmar, become subject with Norway to the crown of Denmark. The country was at this time divided into two parties. There was a Danish party headed by the Archbishop of Upsala, and a Swedish party, which upheld the independence of the country, headed by the administrator whom it had raised to power. Gustavus fought with distinction under Sture against the Danes in 1517 and 1518. He was one of six nobles sent by Sture to Christian II. in 1518 as hostages for the safety of the king during an interview. Christian sent him to Denmark, where he was put under the charge of one of his relations, Eric Baner, lord of Kallö in Jutland. Here he remained more than a year, but hearing of the preparations made to subdue his country, he effected his escape, and reached Lübeck in 1519. After wandering about for some time as a proscribed fugitive he took refuge in the mines of Dalecarlia, where he worked as a common labourer. At length, after various adventures, he collected some adventurous spirits, and betook himself to open resistance. Christian II. was crowned at Stockholm on 4th November, 1520. On the 8th the heads of the Swedish party, among whom was Gustavus' father, were executed. By the beginning of 1521 Gustavus had raised a considerable force, driven the Danes from several positions, and excited a general insurrection in Dalecarlia. On 29th April he defeated the Danes at Westeraas; in July he seized Upsala. On 24th August he was named adminstrator of the kingdom by the states which had assembled at Wadstena. On 6th June, 1523, he was elected king by the Diet of Strengnäs. On the 20th he became master of Stockholm, which he had besieged three times. He deferred his coronation to avoid taking the oath to support the church, as he had become a convert to Lutheranism, and had determined to humble the clergy, whose power was excessive. In 1527 he obtained the exclusion of the bishops from the senate, and their subjection to the civil power. He now openly professed Lutheranism, and was crowned by a Protestant archbishop of Upsala on 12th January, 1528. The Lutheran religion was formally established at a diet held at Örebro in 1529. He formed an alliance with Frederick I. of Denmark against the deposed Christian II., who had landed in Norway in 1531, and been joined by Trollé, the deposed Archbishop of Upsal, and other Swedish malcontents. He entered into an alliance in 1535 with Christian III. of Denmark against the Lübeckers. A protracted insurrection of the peasantry, to put an end to the privileges of the nobility, engaged his attention from 1537 to 1543. In 1544 the states assembled at Westeraas declared the kingdom hereditary in his house. A war broke out with Russia in 1555, which was concluded by the Peace of Moscow, April 2, 1557. He died at Stockholm, 29th September, 1560.

GUSTAVUS II., GUSTAVUS ADOLPHUS, the greatest monarch of Sweden, was a grandson of Gustavus Vasa, was born at Stockholm in 1594, and received a most careful education. He was master of Greek and Latin and several modern languages. He was trained to war under experienced generals, and at the age of sixteen he took his place in the state council. Charles IX., the father of Gustavus, had been declared king to the exclusion of his nephew Sigismund, who, on accepting the crown of Poland during his father's lifetime, had abjured the Protestant religion. On the death of Charles Gustavus succeeded him, with the consent of the states, as king elect. Sweden was at this time at war with Denmark, and Gustavus, then in his seventeenth year, was in command of the army. He chose for his chancellor and first councillor Axel Oxenstiern, a man ten years his senior, but already eminent for his ability, and who eventually proved himself to be one of the greatest of European statesmen. The war with Denmark was concluded through the mediation of England in 1613. A new enterprise at this time presented itself to the ambition of Gustavus—the throne of Russia was vacant and contested. A party favoured the election of Charles Philip, the brother of Gustavus, and was supported by a Swedish invasion under General de la Gartie, who had penetrated to Novgorod; while the Poles, who had also invaded Russia, had reached Moscow. Michael Romanoff was, however, elected czar. Gustavus took a personal share in the Russian war, which continued for about four years after this election, and in conjunction with La Gardie had made considerable conquests in Livonia and the neighbouring provinces, when peace was concluded at Stolbova in 1617. In 1620 he married Eleanora, sister of the Elector of Brandenburg. The war with Russia was followed by a protracted war with Poland, with which, owing to the claims of Sigismund, Gustavus could hardly be said to have ever been at peace. The war lasted nine years, and was concluded on advantageous terms for Gustavus by a six years' truce in September, 1629. He had made important conquests, which he was allowed to retain, in East Prussia.

His attention was now diverted from northern wars by the affairs of Germany. The oppression of the Protestants by Ferdinand II. excited his sympathy. He was alarmed by the progress of Wallenstein, which threatened to extend the empire to the Baltic, and by leaguing himself with the Protestants of Germany he might hope for easier and more extensive conquests than by struggling single-handed against the northern powers. He named his daughter Christina heiress to the throne, embarked for Germany on 30th May, 1630, and landed on 24th June with an army of 13,000 men in the island of Usedom on the coast of Pomerania. The details of his career in Germany will be found more fully in our article on the Thirty Years' war. After repeatedly defeating the imperial generals, and conquering a great part of Germany, he was killed in the battle of Lützen, 16th November, 1632. Gustavus differed from some other great commanders in preferring a small well-ordered army to a large one. He used to say that all over 40,000 men were an incumbrance. His character made him beloved by his soldiers, and he was served with a devotion which enabled him to effect great things with small means. The discipline he imparted to the Swedish army, and the prestige of success derived from his victories, lasted long after his death. His body was taken to Sweden. See

the works by Stevens (1885), Trench (1886), Fletcher (1891), and Dodge (1896).

GUSTAVUS III., King of Sweden, born in 1746; succeeded his father, Adolphus Frederick, on 12th Feb. 1771. Finding the country distracted between two aristocratic factions, the adherents of France and Russia respectively, he resolved to bring in a new constitution and to increase the power of the crown. He effected his purpose by means of a sham revolt, which enabled him to assemble troops, wherewith he surrounded the assembly of the states-general, and forced them to accept his constitution, which, as it only circumscribed the privileges of the nobility, was generally popular. In 1788, when war had broken out with Russia, the nobles revenged themselves by inducing the states-general to refuse him supplies. To free himself from the hostility of the nobles he determined on another *coup-d'état*, which he executed on 3rd April, 1789, by causing the leaders of the opposition to be arrested, and then passing a law extending the royal prerogative. His hatred of the principles of the French revolution induced him to make the most strenuous exertions to form a coalition against France. The Swedes were opposed to an alliance with Russia, and a diet which Gustavus assembled at Gefle for the purpose of procuring supplies, though surrounded with troops, proved so refractory that he was obliged to dismiss it, Feb. 24, 1792. The nobles had long before this formed a conspiracy against him, and resolved on his death. Three of them took an oath to murder him, and drew lots which should carry out their intention. The lot fell on Captain Ankarstrom, who shot the king in the back at a masquerade given in the opera-house at Stockholm, 16th March, 1792. He died on the 29th March. See Bain's Gustavus III. (1895).

GUSTAVUS IV. (Adolphus), King of Sweden, was born on 1st November, 1778, and succeeded, on the death of his father, 29th March, 1792, but was under the guardianship of his uncle, the Duke of Sudermania, till 1796. In 1796 he visited the court of Catharine II. of Russia, and proceeded so far towards a marriage with her grand-daughter, Alexandra Paulovna, that the court was assembled for the marriage ceremony, when the king drew back and refused to sign a marriage-contract because the princess was to be allowed the free exercise of her religion. He afterwards married Frederica, princess of Baden. On assuming power Gustavus showed that he had inherited his father's hatred of the principles of the French revolution, which he carried to the extent of fanaticism. He joined the second coalition contrary to the wish of his subjects. In 1803 he made a journey to Germany to promote a union of the German princes against Napoleon. He was at Carlsruhe when the Duke D'Enghien was seized, and sent his aide-de-camp to Paris to protest against that act of violence. After the Peace of Tilsit he exposed himself to a war with Russia while he was also at war with France, by refusing to join the Continental blockade and opening his ports to England; and in 1808 he quarrelled with England, his only ally. His internal policy was as bad as his external. His subjects were oppressed with taxes to support his wars, and had in return the humiliation of finding Pomerania in the possession of France and Finland in that of Russia. Their patience was at length exhausted. A conspiracy was formed against him, and he was deposed in 1809, his uncle, the Duke of Sudermania, being proclaimed king under the title of Charles XIII. In the following year he adopted as his successor, Bernadotte, prince of Pontecorvo. Gustavus died at St. Gall, 7th February, 1837. He took the title of Colonel Gustafson, and left, among other writings, Memoirs of Colonel Gustafson.

GUSTO, an Italian word signifying *taste*. It occurs in the musical phrase *con gusto*, which signifies that the performer is to enter into the spirit of the passage, and not to play it mechanically.

GÜSTROW, a town of Mecklenburg-Schwerin, on the left bank of the Nebel, 20 miles south of Rostock. It is well built, and has a cathedral of the thirteenth century, a fine parish church, an old castle (now workhouse), a town-house, court-house, theatre, and infirmary; manufactures of machinery, tobacco, soap, sugar, conserves; iron-foundries, breweries, &c. Pop. (1895), 17,531; (1900), 16,882.

GUTENBERG, Johannes, believed by many to have originated printing with movable types, is supposed to have been born at Mainz between 1397 and 1410. Very little is known of his personal history, and recent investigations have shown that particulars, hitherto accepted, are unreliable or inaccurate. Indeed, some documents on which his claims as the discoverer of typography were partly based have been proved to be forgeries. The chief facts regarding him are gleaned from legal proceedings in which he was engaged; but, unfortunately, the original records of the courts have been destroyed, and doubt has been thrown on the accuracy of the transcripts of them. His father's name was Gensfleisch, but he took his mother's maiden name of Gutenberg. The early years of his life are a complete blank. In 1439 one Dritzehen instituted at Strasburg a suit against him for the restitution of money alleged to have been invested in a certain speculation, or, as an alternative, to be admitted as partner in the enterprise. Witnesses gave evidence that Gutenberg was practising several industrial arts at the time, one of them being a great secret. Some curious particulars of tools and pieces of wood to form a press were given in the depositions, and apparently refer to experiments connected with printing. The result of the action was adverse to Gutenberg in regard to the money, but Dritzehen was not admitted as a partner. In 1448 Gutenberg was registered as a citizen of Mainz. In 1450 he procured capital from a goldsmith and money-lender named John Fust, and a sort of bill of sale was given over the materials in his workshop. With this money it is believed that he completed his invention. The first product of the new art is supposed to be an Indulgence of Pope Nicholas V. issued to such as should contribute money to aid the King of Cyprus against the Turks. A copy preserved at the Hague has the date filled in with a pen, Nov. 15, 1454. Other editions of this Indulgence were printed, copies of which have been preserved. The next products of the Gutenberg and Fust partnership were two splendid editions of the Vulgate, called respectively the 42-line and the 36-line Bible, because there are that number of lines in each column, the former being also known as the Gutenberg Bible or the Mazarine Bible, because a copy found in the library of Cardinal Mazarin was instrumental in first fixing the date of production of the book. The two were probably finished about 1454. In 1455 Fust brought a suit for the recovery of the money advanced to Gutenberg. In the result the materials and printing-office were taken possession of by Fust, who selected one Peter Schoeffer, already employed in the printing-office, to carry on the work. By him the first book with a printed date, the Psalter of 1457, was executed. Gutenberg then started a new office at Mainz, being assisted by the city-clerk, Dr. Humery. In 1460 he is believed to have printed the Catholicon—a grammar and technological dictionary. In 1466 a printing-office which contained Gutenberg's types was in operation at Eltville, a small town near Mainz. About this time Gutenberg was made one

of the gentlemen of the court of Adolph II. His death is supposed to have taken place about 1468. Gutenberg's name does not appear in any production of his press, nor do any of his friends and patrons mention him in connection with the invention of printing. See Dr. A. van der Linde's Gutenberg (Stuttgart, 1878) and Geschichte der Erfindung der Buchdruckkunst (3 vols. Berlin, 1886); compare also J. H. Hessels' Gutenberg: Was he the Inventor of Printing? (London, 1882); Haarlem the Birthplace of Printing, not Mentz (London, 1887); E. Gordon Duff's Early Printed Books (London, 1893); also works cited at COSTER.

GUTHRIE, THOMAS, a Scottish divine, eminent as an orator and philanthropist, was born at Brechin, Forfarshire, in 1803. He was the younger son of a merchant and banker of Brechin, with which town his family had been honourably connected for more than 200 years, while it had numbered among its members some names distinguished in the history of the church. Thomas Guthrie was sent at the age of eleven to the University of Edinburgh, and was licensed as a preacher in connection with the Church of Scotland at a very early age. Having expectations of patronage from the Panmure family he does not seem to have required to exert himself much to procure a church, and the interval of leisure which the completion of his studies afforded was turned to account in acquiring a variety of experiences which were afterwards of great value to him. While preaching occasionally on Sundays, he assisted his father in the business of the banking office. He took also a lively interest in the study of medicine, and spent the winter of 1826–27 in Paris, attending medical classes and visiting hospitals. If his academic career was somewhat deficient from having been begun, according to the practice then prevalent in Scotland, at a too early age, he thus gained a compensation in practical knowledge. In 1830 he was presented by the crown, at the instance of the Hon. William Maule, afterwards Lord Panmure, to the parish of Arbirlot, in Forfarshire. The method of preaching which he here adopted was that for which he afterwards became distinguished. His first aim was to make himself understood, and as he found illustrations the most effective means of accomplishing this object he gave special attention to them. In 1837 he accepted a call to the parish of Greyfriars, Edinburgh. He soon crowded his church with a congregation drawn from the first ranks of Edinburgh society. Among the numerous persons of position and influence who attended his ministry it is sufficient to mention Lords Jeffrey and Cockburn, and Hugh Miller. His heart, however, was set upon territorial work, and as Greyfriars was a collegiate or double charge, he obtained its division, and became in 1840 the minister of a new parish in a church erected close to the Cowgate, and called St. John's. The Disruption controversy had begun before Guthrie came to Edinburgh. He took part with the non-intrusionists, and was active in attending public meetings on behalf of their party throughout the country, while the peculiar qualities of his oratory made him one of the most successful exponents of their principles. In 1843 he resigned his charge, and left the Established Church along with his party, which then formed the Free Church of Scotland. His congregation, like most of those attending on the non-intrusionist ministers, joined in this movement, and were accommodated in the Wesleyan chapel, Nicholson Square, until Free St. John's was built for them on Castle Hill. Here Dr. Guthrie's popularity as a preacher was deepened and extended. Besides a regular congregation, as large as the church would hold, there was a constant overflow of visitors. It became one of the fashionable conditions of a visit to Edinburgh to go to hear Guthrie preach. In the Free Church there were minds of a more powerful calibre, Chalmers, Candlish, and Cunningham, by whom its organization was chiefly effected; but there was something left for Guthrie to do. The condition of the country ministers who had left their manses, usually for smaller stipends, evoked his sympathy. A few years after the Disruption he proposed the establishment of a General Manse Fund, and volunteered to travel the country as its advocate. This campaign, in which he engaged in 1845–46, was one of the greatest achievements of Guthrie's life. Most of his family were at this time attacked with scarlet-fever, but his heroic spirit refused to let private feeling interfere with a public work to which he had set himself, and he only indulged in an occasional hurried visit. The amount he had determined to raise was £100,000, and it was largely exceeded. The next great work in which he engaged was that with which his name is chiefly identified out of Scotland, the introduction into Edinburgh of the ragged school system, then recently originated in London and Aberdeen. Into this work he threw himself with characteristic energy, employing in it both his personal labours and his pen. His Plea for Ragged Schools (1847) remains one of the most celebrated of his productions. A controversy soon arose as to the management of the schools in Edinburgh. A large party wished to give effect in the teaching to the religious differences of the parents. Guthrie held that in the case of neglected children the directors of the school stood *in loco parentis*, and insisted on giving uniform Bible instruction. A separation accordingly took place, the Original Ragged School represented Dr. Guthrie's views, the United Industrial School those of his opponents. In 1864 Dr. Guthrie, who had for some years had as his colleague Dr. William Hanna, son-in-law of Dr. Chalmers, was compelled in consequence of disease of the heart, which had begun in connection with his exertion for the manse scheme, to desist altogether from regular pulpit ministrations, and consequently he resigned the pastorship of St. John's congregation. The remaining years of his life were spent in active promotion of philanthropic objects. He became editor of the Sunday Magazine in 1864, but never assumed full editorial responsibility. He travelled in France and Italy, became interested in the Waldensian Church, and attended numerous meetings in England and Scotland to advocate its cause at considerable risk to his health. He also preached occasionally, and sometimes drew forth enormous collections for charitable or religious purposes. He interested himself in the project for union of the Nonconformist churches in Scotland, but beyond some contributions from his pen his health did not permit of his taking any active part in the movement. He died 24th Feb. 1873. Guthrie's popularity rested chiefly on his powers as an orator. He possessed in large measure the kindred qualities of pathos and humour, and had the indispensable adjuncts to an orator of a rich voice, mobile features, and a commanding figure. As he never indulged in familiarities in the pulpit the full range of his powers was only displayed on the platform. He thoroughly understood human nature as in public meeting assembled. It was to him a plastic material in which he worked as an artist, moulding it in various forms, sometimes with a fantastic wilfulness which showed a consciousness of his power. In the course of a few minutes he could move an audience from laughter to tears and from tears to laughter again. His humour was without malice, and an adversary overwhelmed with ridicule could frequently join in the laugh. Yet his oratory was not of the

highest class. It was wanting in depth of intellectual power. Besides his power of touching the feelings, his strength lay in his keen observation, shrewd common sense, and in the qualities of his imagination, particularly in fertility and felicity of illustration. With this description correspond his published works. Until his fame as an orator was firmly established he published nothing but brochures upon current questions. His subsequent works, which were numerous and widely circulated, consisted chiefly of sermons, and may be regarded as the outcome of his popularity as a preacher. He received the degree of D.D. from the University of Edinburgh in 1849, the first instance of their conferring that honour upon a Free Church minister. Among his leading works are, The Gospel in Ezekiel (Edinburgh, 1855; fortieth thousand, 1863); Christ, and the Inheritance of the Saints (1858; twelfth thousand, 1859); A Plea for Drunkards (1856); The City, its Sins and Sorrows (1857).

GUTS-MUTHS, Johann Cristoph Friedrich, born in Quedlinburg, 1759, was the first German author who wrote extensively on the various exercises included in the modern gymnastics. Guts-Muths was, for a long time, a teacher in the institution of Salzmann, at Schnepfenthal, and died on May 21, 1839. He wrote several works on gymnastics, among them Gymnastik für die Jugend (1793, reprinted 1893); Turnbuch für die Söhne des Vaterlandes (1817); Katechismus der Turnkunst (1818); and Spiele zur Uebung und Erholung des Körpers und Geistes für die Jugend (1796, new edition 1893). He wrote, too, a Geography (two vols. 1810–13), and edited a Bibliothek der pädagogischen Literatur Deutschlands—Library of German Educational Works (1800–20).

GUTTÆ, in architecture, small pendent ornaments in the form of conical frusta, or sometimes cylindrical, placed on the under surface of the mutules and beneath the triglyphs of Doric structures.

GUTTA PERCHA (pronounced pertsha), a substance which has been known generally and used in Europe only since about 1845, though travellers and residents in the East were acquainted with it long before, and had seen various articles made of it, though without knowing the nature of the material. It is the inspissated milky juice of several large trees belonging to the order Sapotaceæ, the principal being *Isonandra gutta*, and is obtained by felling the large and old trees, cutting off rings of bark at intervals along the stem, collecting the juice which issues, and concentrating by evaporation, if necessary. The result of this terribly wasteful process is, that the gutta percha tree has been exterminated from various districts in which it was formerly abundant. The tree is found in the Malay Peninsula, and in various islands of the Malay Archipelago in great numbers and of large size; and in some parts at least the juice is now obtained by tapping or making incisions in the trees instead of felling them, while plantations of young trees have also been established. The quantity imported annually into Britain amounts to between 2400 and 4000 tons, but part of this consists of balata or other substances resembling gutta percha.

The crude substance is gray or reddish, mixed with fragments of bark, leaves, and other impurities, from which it is separated by washing with cold and then with warm water. This softens the gutta percha, and the impurities can be easily picked out. When pure it has a brown colour; at the ordinary temperature it is hard and tough, and, in not too thick pieces, is flexible like leather. It is elastic only to a very slight extent, and cannot be beaten out. It has little or no adhesion for other bodies, but its own cohesiveness is remarkable, a thin strip of it bearing a very considerable weight. When warmed it gradually softens, and then can be drawn into fine fibres, rolled into sheets, or moulded. For the latter purpose it is admirably adapted, as when warm and soft it takes the finest impressions, which it retains after it has become cold and hard. When heated to a sufficiently high temperature in the air it catches fire, and burns with a bright flame; heated in close vessels it gives off oily hydro-carbons and an acid liquor, so that gutta percha seems to consist mainly of carbon and hydrogen, with some oxygen, while nitrogen is absent, or present only in very minute quantities. Attempts have been made to resolve gutta percha into proximate constituents, and accordingly three substances extracted from it have been described. These are named respectively *gutta*, which is the chief constituent, and when pure is white and opaque, *alban*, a white oxygenated crystalline substance, and *fluavil*, also oxygenated, and of a yellow colour. These two are said to be formed from the first by oxidation, but there is a considerable diversity of opinion on the nature of these bodies. Ordinary gutta percha is insoluble in water, partially in alcohol and ether, readily and completely in chloroform, turpentine, benzol, bisulphide of carbon, and naphtha. It is also dissolved to a slight extent by oils. It is not attacked by solutions of alkalies, nor by hydrofluoric acid; but it is acted on by sulphuric, nitric, and hydrochloric acids—being darkened in colour, oxidized, rendered brittle, or altogether disintegrated, and by chlorine, which transforms it into a white substance like ivory. It is also affected by the oxygen of the air, especially in light, becoming brittle, resinous, and acid, and it combines with sulphur, and like caoutchouc, can be vulcanized. Gutta percha is used for a great many purposes—especially is it used in submarine telegraph cables, because it is naturally a good insulator of electricity, is not affected by water, is very pliant, and forms a uniform and close-fitting coating to the copper wires. It is much prized for making certain kinds of surgical instruments, and in sheets for surgical dressing. It has been made into water-pipes, and tubes of various kinds, machine-belting, soles for shoes, golf balls, goloshes, buckets, picture-frames, &c.

GUTTER, an open channel for conveying water from roads, or from the roofs of buildings. In ancient buildings the water was discharged from the gutters running along the eaves in spouts called gargoyles, frequently representing figures of animals or grotesque monsters, from whose mouths the water was discharged. The water is now generally carried to the ground in pipes.

GUTTURAL (from the Latin *guttur*, the throat) signifies, in grammar, a sound produced chiefly by the back parts of the cavity of the mouth, as the German and the Scotch *ch*. The letters *k* and *g* in English may be classed as gutturals. The Arabian language is full of gutturals, and many of them are unknown in most other languages. The Irish *r* is a true guttural.

GÜTZLAFF, Karl, D.D., a zealous Christian missionary, was born 8th July, 1803, at Pyritz, in Pomerania; and although in early life he showed a strong disposition for the missionary calling, he was apprenticed to a belt-maker in Stettin. Through the intervention of the King of Prussia, before whom, on his visit to Stettin in 1821, he laid his wishes in a poem, he was placed in the Jänike missionary institution in Berlin, from which about Easter, 1823, he was sent to the Netherlands Missionary Society at Rotterdam. He was chosen by this society as a missionary to the Battas in Sumatra, and after the necessary preparations he set out for India in August, 1826. As a war had broken out in Sumatra he was detained in Java, and took up his residence in Batavia. After four years spent in Batavia, Singapore, and Siam he

went in 1831 to China, and in the course of the next two years made three voyages along the coast, the journals of which he afterwards published. He landed at various places previously unknown to Europeans, and by adopting the dress of the people, and associating familiarly with them, acquired a knowledge of the Chinese language such as was then a rare accomplishment for a European. In 1835 he was engaged by the British superintendency as a first interpreter, and acted in that capacity during the first Chinese war. He was afterwards appointed Chinese secretary to the British plenipotentiary and superintendent of trade. He visited Europe in 1849, and died at Victoria, Hong-Kong, 9th August, 1851. Dr. Gutzlaff was indefatigable in his exertions to diffuse the knowledge of Christianity among the Chinese. His whole leisure after his acceptance of a government appointment was devoted to this object. From the dawn of day he was engaged in study or in prayer with his Chinese converts, and the hours spent in the government offices were the only interruption to his work. His disposition was sanguine, and he was very indulgent to the lapses of his converts, believing that instruction was all that it was in his power to impart, and that the conversion of the heathen was to be looked for only from God, and in answer to prayer. He taught three classes of Chinese converts daily, besides preaching out of doors, all without remuneration. His principal works are: Journal of Three Voyages along the Coast of China in 1831, 1832, and 1833 (London 1834); China opened, or a display of the Topography, History, &c., of the Chinese Empire (1838); Geschichte des Chinesischen Reichs (Stuttgart, 1847).

GUY (nautical), a rope used to keep steady any weighty body from bearing or falling against the ship's side, while it is hoisting or lowering, particularly when the ship is shaken by a tempestuous sea.

Guy is also the name of a tackle used to confine a boom forward when a vessel is going large, and to prevent the sail from shifting by any accidental change of the wind or course, which would endanger the springing of the boom, or perhaps the upsetting of the vessel.

Guy is likewise a large slack rope, extending from the head of the main-mast to the head of the fore-mast, and having two or three large blocks fastened to it. It is used to sustain a tackle to load or unload a ship with, and is accordingly removed as soon as that operation is finished.

GUY, Thomas, the founder of Guy's Hospital, was the son of a lighterman in Southwark, and born in 1645. He was brought up a bookseller. He dealt largely in the importation of Bibles from Holland, and afterwards contracted with Oxford for those printed at that university; but his principal gains arose from the disreputable purchase of seamen's prize tickets in Queen Anne's war, and from his dealings in South Sea stock in 1720. By these speculations and practices, aided by the most penurious habits, he amassed a fortune of nearly half a million sterling, of which he spent upwards of £200,000 in building and endowing his hospital in Southwark. He also erected almshouses at Tamworth, furnished three wards of St. Thomas' Hospital, and benefited Christ's Hospital and various other charities, leaving £80,000 to be divided among those who could prove any degree of relationship to him. He was member of Parliament for Tamworth from 1694 to 1707. He died in December, 1724.

GUY DE CHAULIAC (*Guido de Cauliaco*), a native of Chauliac, on the frontier of Auvergne, France, lived in the middle of the fourteenth century, and was the physician of three popes. He is to be considered as the reformer of surgery in his time. His Chirurgia Magna contains most of the opinions of his predecessors. It was long considered as a classical text-book; was finished at Avignon in 1363, and was printed at Bergamo (1498, folio). An older edition is mentioned (Venice, 1470, folio). It has been often reprinted, commented on, and translated into modern languages.

GUYENNE. See Guienne.

GUYON, Jeanne-Marie Bouvier de la Motte, Madame, a celebrated mystic, the introducer in France, in the reign of Louis XIV., of the system of Quietism, was born at Montargis (Loiret), 13th April, 1648. The excessive development of her imagination at an early age caused her parents much anxiety. She was successively placed in and withdrawn from several convents, and the impression made on her mind by the reading of the legends of the saints made her constantly talk of taking the veil. Her father hastened to marry her. At the age of sixteen (18th January, 1664) she espoused Jacques Guyon, son of the contractor for the canal of Briare. This plan was for a time successful. She attached herself to her husband, to whom she bore five children. But in 1676 her husband died, her mystic ideas again acquired the ascendency, and about two years after she began the religious propagandism which, by exposing her to a long series of persecutions, has made her name famous. She became associated with some enthusiastic priests, Fathers La Motte and Lacombe, and Aranthon, bishop of Geneva, by whose advice she abandoned her children and her goods, reserving a moderate annuity, and retired first to Annecy, then to Gex, where she was for a short time superior of a convent of converted sisters; then to Thonon, where the Barnabite convent of Père Lacombe was situated; then to Geneva. She subsequently travelled through La Bresse, Dauphiny, and Piedmont, exercising a powerful influence on weak and imaginative minds, and making numerous proselytes. She also published numerous works, some of the principal of which may here be noted: Le Cantique des Cantiques interprété selon le sens mystique (1685); Poésies spirituelles (five vols. 1685); Moyen court et facile de faire l'oraison du cœur (1688); les Torrents spirituels (1704); Discours chrétiens et spirituels sur divers sujets (1716); Mes justifications, left in manuscript.

The work in which her system is most fully developed, Les Torrents spirituels, circulated in manuscript long before it was printed. In it she describes the sentiments proper to those who adopt her views. 'These souls,' she says, 'are torrents which have issued from God, and which find no repose until they return into him and lose themselves, never again to find themselves. They do not, however, lose their nature, nor their reality, but their quality. The soul no longer perceives God as by instinct and out of itself, but as having him in itself. No more desires, no more even of love, of light or of knowledge, no more conscience, but identity. Everything is alike to that soul, for everything to it is equally God; it sees nothing but God as he was before the creation. The soul in this state, as long as it does not withdraw its surrender to God, is infallible. Although all creatures should abandon it, it would feel less disturbance than from a fly.' With this speculative mysticism there appears to have been joined, at a later period, some grosser and more materialistic views. Madame Guyon imagined herself to be filled with a spiritual influence which overflowed from her person; and her enthusiastic disciples imagined they experienced its effects.

In 1688 Harlay, archbishop of Paris, thought it necessary to take proceedings against the spread of Madame Guyon's doctrines. He caused her to be

confined in the convent of the Visitation in the Faubourg St. Antoine, Paris; while Father Lacombe, accused of encouraging her errors, was incarcerated in the Bastille. Madame Guyon remained eight months in the convent of the Visitation, but the object of her seclusion was quite frustrated; she found it an excellent school for propagating her views, which the grace of her manner and the natural powers of attraction with which she was endowed, together with the ascendency of a superior mind, enabled her to do with great success. Her writings and the sympathy created by the restraint to which she was subjected at the same time procured her powerful protectors without, who, by their influence with Madame Maintenon, at length procured her release. Madame Maintenon herself now became a disciple of Madame Guyon, and allowed her to preach in her seminary at St. Cyr, where her doctrines made rapid progress, and where she became associated with Fénelon, between whom and Madame Guyon a fast friendship, based on mutual sympathy, was formed. Nothing affords a higher notion of the mental calibre of Madame Guyon than her relations with the Archbishop of Cambrai. It was she who in their spiritual intercourse was the director of the archbishop, and until compelled by superior authority to disavow her doctrines, the author of Télémaque became her disciple. Madame Maintenon attempted to gain the king to a belief in her reveries, but finding him immovable she became alarmed and abandoned her protégée. Madame Guyon retired for a time from Paris, but the agitation produced by her doctrines continued, and her moral conduct was attacked. She demanded to be judged by a commission half lay and half ecclesiastical. A commission was appointed, but it consisted exclusively of ecclesiastics: Bossuet, Noailles, bishop of Chalons, and Fénelon were its principal members. Bossuet, the leading spirit of the commission, was strongly opposed to the views of Madame Guyon, as being contradictory of the doctrines of revelation, and especially to the mediation of Jesus Christ, and he procured their explicit condemnation in a judgment consisting of thirty-four articles. Fénelon, who adhered to the judgment, was only able to effect slight modifications in favour of Madame Guyon. This judgment was signed 10th March, 1695. Madame Guyon subscribed it, and obtained from Bossuet a certificate of the purity of her morals. She at first retired to a convent in Meaux, but having returned to Paris and begun again to disseminate her views, she was imprisoned towards the close of 1695, first at Vincennes and afterwards in the Bastille. Noailles, who had recently succeeded to the archbishopric of Paris, caused her to be liberated and placed in a convent in the Rue Vaugirard. On 28th August, 1696, she signed a declaration drawn up by Fénelon and Tronson. In 1698 Father Lacombe, who was still confined at Vincennes, and shortly afterwards died, was induced, it is supposed in an aberration of reason, to sign a paper exhorting Madame Guyon to repent of her culpable intimacy with him. The king, upon this declaration, ordered her to be again sent to the Bastille. One of her sons who was in the French guards was at the same time dismissed. Although the purity of her character was acknowledged in an assembly of the clergy held at St. Germains in 1700, she was not liberated till 1702, when she was exiled to St. Dizier. The rest of her life was spent in retirement and in works of charity. She died at St. Dizier, 9th June, 1717. That Bossuet and other ecclesiastics should concern themselves with the dissemination of Madame Guyon's views, and express their condemnation of them, was perfectly reasonable, but in regard to the personal persecutions to which she was subjected there can at the present day be only one opinion.

GUY'S HOSPITAL, in the borough of Southwark, was founded in the year 1723, at 'the sole cost and charges' of Thomas Guy, citizen of London and freeman of the Stationery Company (see GUY, THOMAS). The original building, which Guy lived to see completed, contained accommodation for 400 sick or incurable persons. It has since been greatly improved and enlarged, and in consequence of a large bequest in 1829 from William Hunt, one of the governors, a new building, containing accommodation for 300 additional patients, has been added, and the hospital is now the largest in the metropolis, the number of beds amounting to 720. Its management is vested in a body of sixty trustees or governors, self-elected, of which the president and the treasurer are the active heads. The number of patients admitted annually to the wards exceeds 5000, and the number of out-patients averages close on 80,000. The medical and surgical staff is correspondingly complete. Attached to the hospital is a celebrated medical school, with lecture-rooms, laboratories, museums, library, &c. The museums contain a unique collection of anatomical and pathological preparations, modelled in wax, excelling in minuteness and accuracy of detail the celebrated collections of Bologna and Florence. New physiological laboratories were opened in 1897. There are usually about 350 students pursuing their medical studies at the hospital. There is also a complete dental school. The benefactions of the founder and of William Hunt, amounting to close on £400,000, were chiefly laid out in landed property, the income from which was till recently sufficient to meet the current expenses of the hospital, though public subscriptions are now required to supplement it.

GUZERAT. See GUJERAT.

GWALIOR, a city and fortress of Hindustan, capital of Gwalior or Sindhia's Dominion (which see), 65 miles S. of Agra. The fortress is the strongest native fortress in India. It stands high above the city, on the summit of a rocky hill, which rises precipitously from the plain, and is perfectly isolated. The entire height is about 340 feet, and the upper part, which is about 200 feet high, is nearly perpendicular. The area at the top covers 2000 acres, with numerous buildings, and cultivated ground. It contains wells and reservoirs of water, and is inaccessible, excepting by steps up the side of the rock. Old Gwalior (pop. about 25,000) is a town lying at the base of the rock, built of stone, and containing some remarkable ruins of temples and an interesting example of old Hindu palace architecture. The new town, called Lashkar (the camp), stretches away from the foot of the rock at some little distance, and though of recent origin, it is already a large and flourishing place, having 89,154 inhabitants in 1901. It contains the residence of the Maharajah. The fortress of Gwalior was founded in 773. It was seized by Sindhia about 1779, taken by Major Popham, 3d August, 1780; recovered by Sindhia in 1784; taken by Sir H. White, 5th February, 1804; given up to Sindhia in 1805, and surrendered to the British, 2d January, 1844. It was again taken by Sir H. Rose from the Sepoys in 1858.

GWILT, JOSEPH, architect, was the son of an architect, George Gwilt, and his elder brother George followed the same profession, and was also distinguished as an antiquary. Joseph was chiefly distinguished as an author, his treatises being considered as authorities in his profession. He was born 11th January, 1784, and was brought up to his profession with his father. He also studied at the Royal Academy. In 1816 he visited Italy. He died 14th

September, 1863. Of his works the following may be mentioned:—A Collection of Madrigals and Motetts of the Sixteenth and Seventeenth Centuries (London, 1815); Novitia Architectonica Italiana, 1818, being notes of buildings and architects made during his voyage to Italy; Sciography, or Examples of Shadows, with rules for their projection (second edition, improved, 1824); Encyclopædia of Architecture (1842); Elements of Architectural Criticism for the use of students, &c. (1837). In 1825 he edited an edition of Sir William Chambers' Treatise on Civil Architecture, with notes, an introductory inquiry into the qualities of the beautiful, and an illustrated section on Greek Architecture. He also translated the Architecture of Vitruvius (ten books, London, 1826), a translation which is regarded with much favour by architects. He contributed the articles on Art to Brande's Dictionary of Literature, Science, and Art, and the article on Music to the Encyclopædia Metropolitana.

GWYNN, ELEANOR, better known by the name of *Nell*, the celebrated mistress of King Charles II., was at first an orange girl, and also gained her bread by singing from tavern to tavern. She became the mistress of Hart and Lacy, the actors, before going in her sixteenth year upon the stage, where she distinguished herself in light comedy. About 1667 she became the mistress of Lord Buckhurst, who surrendered her about 1670 to the king. She caused much embarrassment to the Duchess of Portsmouth, who deemed herself too refined for such a rival. It is said that in her elevation she showed her gratitude to Dryden, who had patronized her in her poverty; and, unlike the other mistresses, she was faithful to her royal lover. From her are sprung the dukes of St. Alban's. She died in 1687, in the thirty-eighth year of her age.

GYGES, the first king of Lydia of the dynasty of the Mermnadæ, dethroned Candaules, and reigned, according to Herodotus, B.C. 716–678; according to Eusebius, B.C. 670–664. He was the favourite of the Lydian king, who, to convince him of the beauty of his queen, showed her to him naked. The queen was so incensed at this shameful act that she ordered Gyges either to murder the king, ascend his vacant throne, and become her husband, or to atone for his curiosity by death. After having laboured in vain to shake the resolution of the queen, he chose the former part of the alternative, murdered Candaules, and was established on the throne in consequence of the response of the Delphian oracle. This is the story as related by Herodotus. There is a fable of a magic ring which Gyges found in a cavern when a herdsman, and which had the power of rendering its possessor invisible, whenever he turned the stone inwards. By the aid of this ring he enjoyed the embraces of the queen and assassinated the king. To have the ring of Gyges was afterwards used proverbially, sometimes of fickle, sometimes of wicked and artful, and sometimes of prosperous people, who obtain all they want.

GYMNASIUM, the name given by the Greeks to the public building where the young men, naked or nearly so (hence the name, from *gymnos*, naked), exercised themselves in leaping, running, throwing the discus and spear, wrestling, and pugilism. This institution was established in most of the cities of Greece, and in Rome under the Cæsars. Its objects, however, did not remain confined merely to corporeal exercises, but were extended also to the exercise of the mind; for here philosophers, rhetoricians, and teachers of other branches of knowledge, delivered their lectures. In Athens there were five gymnasia, and among them the Academy, the Lyceum, and the Cynosarges. In the first, Plato taught; in the second, Aristotle; and in the third, Antisthenes. They were at first only open level places, surrounded by a wall, and partitioned off for the different games. Rows of plane-trees were planted for the purpose of shade, which were afterwards changed into colonnades with numerous divisions. The gymnasia, at last, were composed of a number of connected buildings, spacious enough to admit many thousands. Vitruvius has given an exact description of the arrangement of them in his work on architecture (v. 11). They usually contained the statues and altars of Hermes and Hercules, to whom the gymnasia were dedicated; sometimes, also, the statue of Theseus, the inventor of the art of wrestling; statues of heroes and celebrated men; paintings and bass-reliefs, representing subjects connected with religion and history. The Hermes figures (see HERMES) were among the most common ornaments of gymnasia. Here was assembled everything that could improve the youth in the arts of peace and of war; everything that could elevate and raise their minds; and while these institutions flourished, the arts and sciences also flourished, and the state prospered. In Rome, during the republic, there were no buildings which could be compared with the Greek gymnasia. Under the Cæsars the public baths or thermæ bore some resemblance to them; and the gymnasia may be said to have expired with the thermæ. See GYMNASTICS.

In Germany the name gymnasium is applied to a class of schools corresponding pretty nearly to the grammar-schools and public schools of Britain. Formerly in these schools Latin and Greek, and the branches connected with antiquity, were taught almost to the exclusion of other subjects; but a more practical bent is given to the course of instruction in these institutions now, though the real-schools, as they are called, are the institutions specially established for high-class education in such branches as mathematics and physical science, history and modern languages. The gymnasia are the feeders of the universities, and the training adopted in them is specially intended to equip the pupils for entering these institutions. The last examination, to show whether the pupils are fit to enter the university, is very severe: the candidates have to write exercises, on questions proposed to them, in history, the Latin and Greek languages, mathematics, besides themes in German, and in at least one foreign modern language. If private schools or (as is the case in several cities) orphan asylums wish to send scholars to the university, they must apply to government for commissioners to attend their examination. Persons who have fitted themselves for the university, without attending a gymnasium, or any school, can be examined by a committee appointed by the government, which sits every half-year.

GYMNASTICS (for derivation and history see GYMNASIUM) is the technical term used to designate any system of exercises specially designed to promote the development of physical, and especially of muscular powers. Such exercises may be either general or special. Special exercises are those designed to train particular muscles, thus in singing or playing on musical instruments the muscles of the mouth and chest, and of the hand and arm, are specially exercised. In as far as these exercises are directly designed to promote the muscular development necessary for the purposes of art, they are truly gymnastic. In the apprenticeship of all trades there is likewise a muscular development which may be classed in the same way. Gymnastics proper are distinguished from all these species of applied gymnastics in this, that they consist in exercises designed to promote muscular development without regard to the particular uses to which the developed power may be applied.

It may be remarked in passing, that singing, dancing, violin-playing, billiards, cricket, foot-ball, bowls, rowing, military exercises, and similar amusements, afford means of physical education or development all the more valuable that it is acquired insensibly, and that such pursuits are more likely to be persevered in than any set of formal exercises which have no interest in themselves. The special value of formal gymnastic exercises is that they are capable of being scientifically arranged so as to secure not only a general development of muscular power, but what is of even greater value, an accurate knowledge of the uses of the various muscles, contributing to the economy of muscular power upon which health as well as successful exertion depends, and especially that they are capable of being applied to each individual case, so as to meet, allow for, and as far as possible overcome defects in physical organization. For these purposes an elementary course of gymnastics is of great value to all, especially to the sedentary student. In regard to the economy of gymnastic exercises two general rules may be laid down, which will form an efficient guide in self-imposed exercises. The first is the universal rule in mechanics that the strength of any machine is the strength of its weakest part; the second is the fundamental law of muscular exercise, that it is exercise within the extreme power of the muscle which developes and improves, while straining weakens and injures, and excessive exercise developes particular muscles abnormally at the expense of the general health. It is quite possible, indeed, to carry physical exercises as a whole too far. The corruption of morals and consequent decline of political power among the Greeks has been attributed, though probably with exaggeration, to the excessive development of gymnastics in their national games. We do not need, however, to go further than our own universities and public schools to perceive that there are two extremes in this matter. A few over-zealous or ambitious students may be found emaciating themselves with exhaustive application to mental toil, while, perhaps, a larger number of jovial well-fed animals may be found at the opposite end of the academic scale, whose whole devotion is to physical pursuits, and who, but for the slight mental stimulus of acting as judges in their favourite games, would allow their brains to vegetate. Between these extremes is the healthful mean of the *mens sana in corpore sano*, which it is the aim of a sound mental and physical education to promote, and towards which gymnastics rightly used form an essential contribution.

The first or elementary stage of gymnastics, which should be practised by children of both sexes, consists in regular series of simple muscular movements without instruments; assuming poses or attitudes, saluting, making various flexures of the arms, legs, or body, rising on the toes, marching, &c. These exercises are performed at first slowly and carefully, afterwards rhythmically to the word of command or the sound of music, such 'musical drill' being now very common in schools. It is said that by a well-regulated course of such exercises, without any accessories whatever, the strength of a boy may be doubled. These exercises form a necessary preparation for the gymnasium, in which, by means of complete apparatus and appliances, all the muscles of the body are regularly trained to their full development. Gymnasiums are fitted with such appliances as horizontal and parallel bars, trapezes hung from the roof, vaulting-horses, ladders set horizontally and otherwise, climbing ropes and poles, weights to be raised by pulleys and ropes, besides such things as dumb-bells, bar-bells, Indian clubs, &c. There are now also pulling apparatus which may be fixed up in private-houses and form a useful means of exercise at home. Gymnastics, both with and without appliances, now form a regular portion of the training of soldiers in the British army. A gymnastic training is most effective when conducted by an experienced master. In default of this, there are many useful little treatises which explain the various kind of apparatus, and give detailed directions for their use.

GYMNOSOPHISTS, the name given by the Greeks to the Indian philosophers, because, according to tradition, they went naked. Of their philosophical systems we know only that they made philosophy to consist in constant meditation and the severest ascetic habits, by which they sought to overcome sensuality, and to unite themselves with the Deity. They often burned themselves alive to become pure the sooner, as Calanus did in the presence of Alexander, and Xarimarus at Athens, when Augustus was there. The little acquaintance of the ancients with the Indies gave rise to many wonderful stories respecting them. They seem to have resembled the modern fakirs.

GYMNOTUS. See ELECTRICAL FISHES.

GYÖNGYÖS, a town, Hungary, romantically situated at the foot of Mount Matra, 21 miles north west of Heves. It is well built, and has a fine castle, with beautiful gardens, and an interesting collection of armour; several Roman Catholic churches, a town-house, gymnasium, and Franciscan monastery. Its staple manufacture is woollen stuffs, and there are alum works in the vicinity. An excellent red wine, called by the Germans Erlauer, is produced in the neighbourhood, which is so like Burgundy as to be often mistaken for it. There is some trade in this wine and in fruit. Pop. (1900), 16,112.

GYPSIES (from *Egyptians*, the name by which they were called in the English statutes), a wandering nation, whose physical characteristics, language, and customs differ much from those of European nations. They are called by the French *Bohémiens*, from the belief that they were Hussites driven from their country; in Switzerland, the Netherlands, and the Black Forest they go under the name of *Heiden* (Pagans); in North Germany, Denmark, and Sweden they are called *Tatern* (Tartars). The name they most frequently pass under in Germany is *Zigeuner*, which is not unlike the Italian *Zingaro* or *Zingano*, the Spanish *Zincalo* or *Gitano*, the Hungarian *Cigán*, the Turkish *Tschinganch*. They call themselves *Romani* or *Romanitchave*, from *rom* (man) and *tchave* (children). The number of Gypsies in Europe is roughly set down at perhaps 700,000. Of this number about 200,000 are in Roumania, 95,000 in Austria-Hungary, 120,000 in European Turkey; 40,000 in Spain; 40,000 spread over Germany, France, and Italy; 18,000 in Britain; and the remainder scattered over other countries. As their English name denotes, the Gypsies were for a long time believed to have come from Egypt, but it is now satisfactorily ascertained that they are of Indian origin, and it is probable that their own name of *Sinte* or *Sinde* corresponds to the Sanskrit *Sain-dhavas*, or dwellers on the Indus. The main body of their language is the same throughout Europe, and even now has a close affinity with the dialects of Hindustan, though it is mixed with a great number of words and expressions borrowed from the races among whom they have sojourned.

Gypsies are remarkable for the yellow brown, or rather olive colour, of their skin; the jet-black of their hair and eyes, the extreme whiteness of their teeth, and for the symmetry of their limbs, which distinguishes even the men, whose general appearance, however, is repulsive and shy. The Gypsies have much elasticity and quickness; they are seldom of a tall or powerful frame; their physiognomy denotes careless-

ness and levity. They rarely settle permanently anywhere. Wherever the climate is mild enough they are found living in forests and waste places in companies. They live in tents, and seek shelter from the cold of winter in grottoes and caves, or they build huts sunk some feet in the earth, and covered with sods laid on poles. In some countries, however, members of the race may be found who follow a settled trade. Thus they are inn-keepers, horse-doctors, and dealers in horses; they are smiths, mend old pans and kettles, and make iron utensils, nails, and the like. Some work in wood, making spoons, spindles, troughs, or they assist the farmer in the fields. Their talent for music has been remarked, but it is confined to instrumental music, which they chiefly practise by the ear. They play on the violin, Jews'-harp, the bugle, flute, and hautboy. Their music for dancing is lively and expressive; there are no better musicians for the Hungarian and Polish national dances. Some of their melodies have become the much-valued property of other nations, or are incorporated in some of our favourite operas. The Gypsies who formerly traversed Germany supported themselves by tricks, the women telling fortunes with cards; the men dancing on the rope, and performing similar feats. The Gypsy women in their younger years, particularly in Spain, are dancers. As soon as they grow older they invariably practise fortune-telling and chiromancy. This is their chief occupation in all parts of Europe. There is no special costume to distinguish the Gypsy. In warm countries the children may go perfectly naked for some years. In England the women often have red cloaks with hoods, and generally a handkerchief tied over the head. They are fond of rings and ornaments. Those Gypsies who lead a settled life are very fond of dress. Their domestic animals are horses and pigs. In England they have always donkeys in their caravans. They are fond of onions and garlic, according to the oriental custom. They eat all kinds of flesh, even that of animals which have died a natural death. Towards the end of last century they were accused in Hungary of having slaughtered human beings and devoured them, and in consequence of this charge were treated with the greatest severity. Their guilt, however, has never been proved. Brandy is their favourite beverage; tobacco their greatest luxury; both men and women chew and smoke it with avidity, and are ready to make great sacrifices for the sake of satisfying this inclination. They have no peculiar religion. Amongst the Turks they are Mohammedans; and in Christian countries they follow the forms of the Christian religion, whether Roman Catholic or Protestant, without, however, caring for instruction, or having any interest in the spirit of religion. In Transylvania they often have their children baptized repeatedly, at different places, for the sake of the money which it is customary in that country for the god-father to give to the poor parents of his god-child. Marriages often take place in church, but at other times they may be celebrated with rites or ceremonies of the simplest kind, often at the age of fourteen or fifteen years. In Hungary another Gypsy may officiate as priest at the wedding. A Gypsy will seldom marry any but one of his race. If he becomes tired of his wife, he will turn her off without ceremony. A Gypsy woman sometimes marries a man of another race. A blind, almost animal love for their children prevents them from punishing them, so that they grow up in idleness, and are accustomed to steal and cheat.

It has been repeatedly proposed to banish this people from Europe. In France and Spain, in Italy and Germany, laws were passed against them in the sixteenth century. But even persecutions were of little avail towards rooting them out. They always appeared again in the southern countries. As they are very numerous in the Austrian states, and have a kind of constitution there amongst themselves, being in a manner governed by chief Gypsies or *voivodes*, the great Maria Theresa formed the plan of converting them into orderly men and citizens. In 1768 she issued an ordinance that in future Gypsies should dwell in settled habitations, practise some trade, dress their children, and send them to school. Many of their disgusting customs were prohibited, and it was ordered that they should forthwith be called *Neubauern* (new peasants). This ordinance remaining ineffectual, recourse was had in 1773 to severe measures; the children were taken from their parents, and brought up in Christian principles. But as little was effected in this way as by the very mild measures adopted by the Russian government. However the ordinances of Joseph II. (1782 et seq.), to forward the improvement of the Gypsies in Hungary, Transylvania, and the Bannat, have not been without effect.

With regard to their language, a large number of the words are of Indian origin, as already mentioned. They are found in part, with little variation, in the Sanskrit, in the Malabar, and Bengal languages, and many words have been adopted from the different nations amongst whom they reside. Bishop Heber relates in his Narrative of a Journey through the Upper Provinces of India, &c. (London, 1828, two vols.), that he met with a camp of Gypsies on the banks of the Ganges, who spoke the Hindu language as their mother tongue. Heber found the same people in Persia and Russia. Their grammar is also oriental, and corresponds with the Indian dialects. This similarity cannot be considered the work of chance, particularly as their persons and customs show much of the Hindu character. It has even been attempted to derive their origin from a particular caste of the Hindus. But this cannot be the respectable caste of the mechanics and agriculturists. They are more probably a branch of the Parias, who are considered contemptible by all the other Hindus, because they live in the greatest uncleanliness, and eat the flesh of beasts that have died of sickness. It cannot, however, be easily explained why this particular caste should have left their country and spread throughout Europe. The Jats, a race near the mouth of the Indus, are believed by many investigators to have been the forefathers of this peculiar people.

In 1417 the first mention is made of the Gypsies in Germany. They appear to have come from Moldavia into Germany and Italy. At that time they already wandered about in hordes with a commander at their head. In 1418 the number which entered Italy alone was estimated at 14,000 men. There were many in Paris in 1429. They were first believed to be pilgrims coming from the Holy Land; they were, consequently, not only unmolested, but they received letters of protection; for instance, from Sigismund, in 1423. It is known, however, that in later times they were very expert in counterfeiting similar documents. What may have been the cause of their leaving their country is not known; but very probably they were induced to flee from the cruelties exercised by Tamerlane on his march into India in 1393. See C. G. Leland's English Gypsies (London, 1872); the well-known works of George Borrow; and also works by F. H. Groome, MacRitchie, &c.

GYPSUM ($CaSO_4, 2H_2O$), hydrated calcic sulphate, and thus distinguished from the anhydrous sulphate, or anhydrite. It was well known to the ancients, who obtained from Syria, and probably from other countries, a stone called by Theophrastus *gypsos*,

which resembled alabaster, and was prepared for strengthening and ornamenting the walls of buildings by burning it in a suitable furnace, and then stirring it about with water, whereupon, after a time, the pasty liquid set into a hard and enduring mass. It was employed, therefore, in the same way and for similar purposes as at the present day. Gypsum is an exceedingly abundant substance, and is met with in a great variety of forms. When it has crystallized freely it forms monoclinic prisms of great transparency and symmetry; in this state it is called *selenite* (which see); the crystals sometimes are massed together in bundles, or radiate from a centre, and a variety of this, from its lustre, is called *satinspar;* when in uniform, saccharoidal, translucent masses, it constitutes alabaster; and it is found, besides, in large beds or rock deposits, constituting ordinary gypsum. The appearance of the different species of this substance varies greatly; the purer kinds are transparent or translucent, with hardly any colour; the commoner kinds are opaque, and the colour varies from white and pale yellow, through red, to brown and black, and blue gypsum is also known.

Gypsum dissolves in 445 parts of water at the common temperature, but is more soluble in hydrochloric acid. When heated alone, water is expelled, but if the temperature has not been too high it retains the power of recombining with it; but if heated to a high temperature it loses this power, and passes into the state of anhydrite; at a still higher temperature it fuses, but with difficulty. By heating in contact with charcoal it is converted into calcic sulphide, and the residue, when moistened with water, and decomposed with an acid, gives off sulphuretted hydrogen. By this process the sparingly soluble sulphate of calcium can be converted into the soluble chloride or nitrate of calcium. Specific gravity, 2·3.

Gypsum in large quantity is usually met with in the salt and coal deposits; but it occurs in beds, in large aggregations, and in thin seams and fibres in all kinds of rocks, though least frequently in the crystalline. One of the most important is the deposit at Montmartre, Paris, but it occurs abundantly in this country, and in other parts of Europe and in America. It contains but few vegetable or animal remains; those that occur are chiefly bones of quadrupeds, amphibia, fresh-water shells, and vegetable remains. Caves are of frequent occurrence in gypsum. The purer semi-transparent specimens of gypsum, or *alabaster*, are used for ornamental works, as vases, urns, &c., and for statuary; for which purposes its softness makes it very useful, and easy to work; but this also renders it difficult to polish. It constitutes the material used in making the fine plaster for the internal finishing of costly edifices, and gives the walls a most beautiful whiteness. (See PLASTER OF PARIS.) Another great and important use of gypsum in some localities is for manuring grass and grain lands. It is indeed very remarkable how great an additional quantity of grass or clover will be obtained by the sprinkling of even a peck of ground gypsum upon the acre of land; though in some cases it seems to fail of due effect.

GYRATION, RADIUS OF. The energy required to set a body in rotation in any given manner depends on the arrangement of the mass of matter to be rotated. Thus, a mass made into a ring like a wheel with very light spokes requires the expenditure of more energy in order to set it to rotate once per second on its axis, than would be required if the same amount of matter were made into a uniform circular plate of the same radius. And if the same mass were made into a sphere still less energy would be required to make it rotate at the same rate round an axis passing through the centre. The energy required to set any given body in rotation about any given axis depends, in fact, on the 'moment of inertia' of the given body about that axis; and the mass of the body being given, the moment of inertia depends on the way in which the mass is disposed about the axis of rotation. The radius of gyration about a given axis is the distance from that axis at which the whole of the matter of the given body might be concentrated without altering the moment of inertia. The moment of inertia and radius of gyration for any given body about any given axis may be calculated mathematically. The two magnitudes are evidently of great importance in the theory of rotating bodies.

GYRFALCON, or JERFALCON. See FALCON.

GYROMANCY (from the Greek words *gyros* or *guros*, a circle, and *manteia*, prophecy), the art of prophesying by means of a circle, described by the soothsayer with various ceremonies, and around which he walks saying magic words and making mysterious motions.

GYROSCOPE, an instrument invented by M. Foucault to show the rotation of the earth on its axis. It consists essentially of a metallic disc capable of being set in very rapid rotation. The disc is supported in a ring, the axis of rotation being a diameter of the ring, and is pivotted so as to rotate with the smallest possible amount of friction. A disc in rapid rotation tends to keep the axis of rotation always pointing in the same direction; and if the ring described above be held in the hands, it will be found that though it may be carried about from place to place in any way, so long as no attempt is made to change the direction of the axis of rotation, any motion whatever which tends to alter the direction of that line meets with extraordinary resistance. Foucault made use of the instrument in the following way:—He supported the ring which carries the rotating disc in a second ring, the axis of support of the inner ring being at right angles to the axis of rotation of the disc. The outer ring was suspended by a torsionless thread from a fixed point, and the disc was set in rotation. A mirror attached to the outer ring was viewed from a distance with a telescope, the image in the mirror of some fixed object being made to coincide with the cross wires. It will readily be understood that as the rings connected with the rotating disc must remain fixed in space, and as the various surrounding objects connected with the earth are moving with its rotation, the object first viewed with the telescope will gradually move from its observed position, and the rate of motion may be compared by calculation with that which ought to be observed in any particular latitude.

GYULA, MAGYAR, and NEMETH, a market town, Hungary, county and 12 miles south-east of Békés, on the Körös, which is here navigable, and traverses a plain between vineyards and morasses. It consists of two distinct villages, on opposite sides of the river; has Protestant, Greek United, and Greek Non-united churches, a castle, and court-house; a trade in salt, cattle, and wine, which is extensively grown in the district. The climate is said to be somewhat unhealthy. Pop. (1890), 19,991; (1900), 22,446

H.

H, the eighth letter and sixth consonant in the English alphabet, having as its most proper and distinctive sound that which is heard in such words as *hart*, *hat*, *when*, *what*, &c. In Latin and ancient Greek it was not considered as a true consonant, but merely as a breathing. The latter language, as is well known, had no literal sign for our *h*, but merely what is called the *rough breathing* (ʽ); and in Latin prosody, when initial, it is not considered as a letter. The character H did exist in Greek, but in the ordinary written language it represented the long sound of *e* (much as in *there*); at an earlier period it was an aspirate, and as such was introduced into the Latin alphabet. An erroneous aspiration early crept into the Latin, of which Cicero complains, and on which Catullus made an epigram. The spelling *pulcher*, *triumphus*, &c., was thus substituted for *pulcer*, *triumpus*, &c. In languages in which *h* is considered a consonant it is generally classed with the gutturals. To represent the sound heard in *hard*, &c., is only a small part of the duty this letter has to perform in English; it is also very commonly joined to other consonants to represent sounds for which there are no special letters in our alphabet, as in the digraphs *ch*, *sh*, *th* (*child*, *ship*, *thin*, *this*), or in other consonantal combinations of various origins and values, as in the words *enough* (where *gh* now is equivalent to *f*), *plough* (*gh* now silent), *philosophy* (*ph*=*f*), *rhetoric* (*h* silent), &c. *Ph* and *rh* are found only in words that are borrowed or derived from the Greek and Latin. *Ch* is also common in words taken from the Greek, but in this case it usually has the sound of *k*, as in *chemistry*, *chyle*, &c. In the earliest English (Anglo-Saxon) *h* appears to have been distinctly guttural, and to have more or less resembled the German *ch*. In many words formerly spelled with the guttural *h* alone we now find the letter strengthened by a *g* before it, as in *night* (A.-Sax. *niht*), *thought* (A.-Sax. *thóht*). In Anglo-Saxon it frequently occurs at the beginning of a syllable before *l*, *n*, and *r*, positions from which it has long disappeared. Thus, *loaf*, *lord*, *leap*, *lean*, as also *raven*, *raw*, *rough*, *ring*, originally began with *h*. So also did *neck*, *nut*, *nit*. The Italians have almost entirely banished *h* as an independent letter; they leave it out at the beginning of words, with few exceptions, because it is not pronounced; and instead of *ph* they write *f*. In the combinations *ch*, *gh* it is used simply to give the *c* and *g* the hard sound before *e* and *i*. In French it is common in the combination *ch* (= *sh* in English); occurring by itself it has no sound, but in various cases it causes a hiatus between vowels. On Roman coins, inscriptions, and in manuscripts H has a diversity of meanings, as *honestas*, *hic*, *hæres*, *homo*, *habet*, *hora*, *honos*, *Hadrianus*, &c. On modern French coins it means the mint of Rochelle. H, among the Greeks, as a numeral, signified 8; in the Latin of the middle ages 200, and H with a dash over it 200,000. In music the Germans use this letter for the note we call B. Our B flat they simply call B.

HAARLEM, or HARLEM, a town of Holland, capital of the province of N. Holland, 10 miles W. Amsterdam, on the railway thence to Rotterdam; and intersected by the Spaarne, which is joined by canals from Leyden and Amsterdam, and along which a considerable traffic is maintained. The town is well and regularly built, with pleasant gardens and promenades partly on the site of its old fortifications. It has broad clean streets, traversed by canals crossed by numerous bridges. Some of the principal streets open into the Groote Markt (Great Market), near the centre of the town, in which stand the town-hall, an old edifice, containing a collection of good pictures, and originally built as a palace of the Counts of Holland; the church of St. Bavon, the finest in Haarlem, with a tower 255 feet high, and an organ, one of the largest and finest in existence; the quaint old Fleshers' Hall; and the statue of Laurens Janszoon Coster, whom Dutchmen generally claim to be the inventor of movable types. There are several Calvinistic, Roman Catholic, Baptist, and other churches, and a synagogue. The hospitals for the aged, the poor, the infirm, and the sick, and other benevolent institutions, are numerous; and there are a gymnasium, Latin school, normal school for teachers, commercial, industrial, and other schools; a valuable public library; the Episcopal museum, containing a collection of ecclesiastical antiquities; several literary and scientific societies, with associations for music and art; Teyler's institution for the promotion of learning, containing a museum of natural history, physical and other instruments, &c., and a gallery of the works of modern artists. In the beautiful public park on the south side of the town is an industrial museum. The manufactures of Haarlem, as well as its population, are less than what they were formerly; but it has still considerable cotton bleaching, spinning, weaving, and printing works, manufactures of caoutchouc, various other industrial works, a celebrated type-foundry, and the oldest and most famous printing-office in Holland, as well as great nursery-gardens and an important flower trade, especially in hyacinths and other bulbs. Haarlem was a thriving place about the middle of the twelfth century. In 1573 it capitulated, after a seven months' siege, to the Spaniards under Alva, who in the contest lost 10,000 men. Contrary to the terms of surrender Alva caused upwards of 2000 persons, including the Protestant ministers, the garrison, and many of the citizens, to be put to death. It is the birthplace of the painters Ostade, Jan Weenix, the Wouvermans, E. Van der Velde, Berchem, Van der Helst, Ruisdael, &c. Pop. (1900), 65,189.

HAARLEM, LAKE OF, a former lake of Holland, adjoining and communicating with the Ij, between Haarlem and Amsterdam. It was about 12 miles long by 7 miles broad and formed a shallow expanse with 6 feet of water and 8 feet of mud. Previously to the fifteenth century it existed only as a swamp of considerable extent near its present centre, but towards the end of the sixteenth century had grown into a large lake, and was only restrained by strong dykes from making farther encroachments. The draining of it was commenced in 1840 and completed in 1853, and 45,000 acres of fertile land recovered. The soil thus reclaimed now forms a commune, which numbers about 16,000 inhabitants.

HABAKKUK, the eighth of the twelve minor prophets. It is inferred from the prophecy which bears his name that he was of the tribe of Levi, and

flourished about 600 B.C. The prophecy commences with a lamentation for the corruption and social disorganization by which the writer is surrounded, and a cry to the Deity for help, which is followed by a reply, promising swift vengeance. The prophet is commanded to write in an enduring form the vision of God's retributive justice as revealed to his prophetic eye. The doom of the Chaldeans is first told in general terms, and the announcement is followed by a series of denunciations pronounced upon them by the nations whom they had oppressed. The whole concludes with a magnificent psalm (chap. iii.), Habakkuk's Pindaric ode, as it is called by Ewald, a composition unrivalled for boldness of conception, sublimity of thought, and majesty of diction. The style of the whole prophecy is remarkable for its purity, terseness, and force.

HABEAS CORPUS, an ancient English writ used for a variety of purposes from remote antiquity. It is addressed to him who has another in custody, and commands him to produce the body of the person named at a certain place and time. One of the purposes for which it was used was to recover freedom when wrongfully taken away. Personal liberty was asserted by the common law from its earliest ages, and it was always assailed by kings who would be absolute, and with an earnestness proportionate to their tyranny. Hence it became imperatively necessary, if subjects were to retain the control and disposition of their own persons, that they should demand a recognition of this principle from their sovereign, and in England the principle was declared in the most solemn manner in Magna Charta. It is there said that 'no man shall be taken or imprisoned but by the lawful judgment of his peers, or by the law of the land.' It became necessary, however, in the course of time to put down the abuses by which the government's lust of power, and the servile subtlety of crown lawyers, had impaired so fundamental a privilege; and this was effected by the Habeas Corpus Act passed in 31 Charles II. (1679). Of the political and social effects of this measure Blackstone writes: 'If once it were left in the power of any, the highest magistrate, to imprison arbitrarily whomever he or his officers thought proper, there would soon be an end of all other rights and immunities. Some have thought that unjust attacks, even upon life and property, at the arbitrary will of the magistrate, are less dangerous to the commonwealth than such as are made upon the personal liberty of the subject. To bereave a man of life, or by violence to confiscate his estate without accusation or trial, would be so gross and notorious an act of despotism, as must at once convey the alarm of tyranny throughout the kingdom; but confinement of the person, by secretly hurrying him to jail, where his sufferings are unknown or forgotten, is a less public, a less striking, and therefore a more dangerous engine of arbitrary government. And yet sometimes when the state is in real danger, even this may be a necessary measure. But the happiness of our constitution is, that it is not left to the executive power to determine when the danger of the state is so great as to render this measure expedient, for it is the Parliament only, or legislative power, that, whenever it sees proper, can authorize the crown, by suspending the Habeas Corpus Act for a short and limited time, to imprison suspected persons without giving reason for so doing.'

The provisions of the act may be stated generally thus:—1. That on complaint or request in writing, by, or on behalf of, any person committed and charged with any crime (unless committed for treason or felony expressed in the warrant; or as, or on suspicion of being accessory before the fact to any felony, or upon suspicion thereof, plainly expressed in the warrant; or unless committed or charged in execution by legal process), the lord-chancellor, or any of the judges in vacation, upon viewing a copy of the warrant or affidavit that a copy is denied, shall (unless the party has neglected for two terms to apply to any court for his enlargement) award a habeas corpus for such prisoner, returnable immediately before himself, or any of the judges; and upon the return made shall discharge the party, if bailable, upon security being given to appear and answer to the accusation. 2. The writ shall be returned, and the prisoner brought up within a limited time, according to the distance, not exceeding twenty days. 3. Officers and keepers neglecting to make due returns, or not delivering to the prisoner, or his agent, within six hours after demand, a copy of the warrant of commitment, or shifting the custody of a prisoner from one to another, without sufficient reason or authority (specified in the act), shall for the first offence forfeit £100; for the second £200, to the party grieved, and be disabled to hold their office. 4. No person once delivered by habeas corpus shall be recommitted for the same offence, on penalty of £500. 5. Every person committed for treason or felony may insist on being tried at the next assizes, or admitted to bail, unless the crown witnesses cannot be ready in that time; and if not tried at the second assizes or sessions, he shall be discharged from the imprisonment. 6. The prisoner may apply either to the Court of Chancery, or to the Courts of Queen's Bench, Common Pleas, or Exchequer, and any judge denying such writ is liable to a fine of £500. The writ may be applied for by persons confined in any part of England, or Jersey and Guernsey, the 25 and 26 Vict. cap. xx., having deprived the English courts of this jurisdiction over the colonies, whenever local courts exist by which such a jurisdiction can be exercised. As the Habeas Corpus Act extended only to cases where persons are imprisoned on criminal, or supposed criminal charges, the other cases being left to the operation of the common law, which was found defective, the statute 56 Geo. III. cap. c. was passed, which extended the writ to other cases. Under this last act any person confined, or restrained of his liberty (otherwise than for criminal matters, and except persons imprisoned under a judgment or decree for debt), may apply to any judge of the common law courts for a habeas corpus, on showing by affidavit that there is a reasonable and probable ground for complaint.

The result is that in all cases whatever, where a person, whether man, woman, or child is illegally confined in England, the remedy is for some friend to apply for a habeas corpus, which, on a good prima facie case, will be issued to the person who so illegally confines the applicant; and if such person refuses to show good legal grounds for what is done, he will be committed for contempt. If the party is confined under recognized authority, as a child by a parent, this fact must be stated. If the party is confined under some legal authority, then the warrant of commitment must be produced, and the rule is that such warrant must set forth the subject-matter, and the jurisdiction of the judge or justice who so committed the party, so that the legality of the imprisonment may be judged of.

In times of great political excitement, and suspected treasonable conspiracies, the operation of the Habeas Corpus Act has been suspended, as in Ireland in 1866, by 29 Vict. cap. i. But such suspension does not enable any one to imprison without cause or valid pretext for so doing. It only prevents persons who are committed from being bailed, tried, or discharged during the suspension, leaving to the committing magistrate all the responsibility attending on illegal imprisonment. It is not uncommon therefore to pass

an act of indemnity subsequently, for the protection of those who either could not defend themselves in an action of false imprisonment, without making improper disclosures of the information on which they acted, or who have done acts not strictly defensible at law, yet apparently justified by the necessity of the moment.

In Scotland similar protection of the liberty of the subject is secured by the Wrongous Imprisonment Act, 1701, cap. vi. The English statute has been copied in the United States without essential change.

HABERGEON, a jacket of chain-mail shorter than the hauberk, and without sleeves, worn in the middle ages by the squires and archers.

HABIT, a tendency or aptitude for the performance of certain actions, acquired by custom, or a frequent repetition of the same act. Animals, as well as mankind, and to some extent plants even, are influenced by this force, which, in many cases, becomes so strong as to deserve the proverbial phrase of being a second nature. The parrot can be taught to repeat words and even sentences, the horse will stop without being pulled up at places where his master had accustomed him to halt. Man is, in a greater measure than is usually recognized, regulated by habit. He becomes attached to the people and the scenes he has been long surrounded with. It is extremely probable that the closest affection of one relation for another may be the result of habit, rather than of the ties of blood. The child early separated from its mother will in course of time cling to its nurse, and look upon its parent with indifference. The beauty which a Laplander or a Hottentot admires in his mistress would fill us with disgust. Viands and beverages which are repugnant to the taste when first partaken of, become afterwards intensely enjoyable. The most daring feats of the gymnast, the most brilliant execution of a musician, have resulted from so frequent repetitions of the same actions, that the will seems to count for nothing, and the mere machine for everything. By habit the judgment, memory, and imagination may be strengthened and developed. Man, so proud of his title of *reasoning* animal, is rather inclined to overlook the importance of habit, which seems to reduce him to the level of a machine. It would be wiser for him at once to recognize the full value and force of habit. If every action and circumstance of everyday life required the effort and reflection they did at the outset, he would not be able to overtake but an infinitesimal part of the work he does, and it is questionable if that fractional part would be done better than the whole now is. His principal object should be to acquire good habits, and it seems impossible to insist too strongly or frequently on the importance of early training in this respect.

HABIT AND REPUTE, in Scotch law, an expression applied to denote something so notorious that it is taken without further proof to be true. Thus, marriage may be constituted by habit and repute, where the parties cohabit and are recognized by the neighbours as man and wife. Also if a person is by habit and repute a thief, that is, a notorious thief, the offence for which he is convicted is considered greater, and the punishment inflicted is heavier. It would appear that, in order to constitute habit and repute in criminal law, the offender must have borne the character for at least six months.

HABITUAL CRIMINALS ACT, an act passed 32 and 33 Vict. cap. xcix. to make further provision for the suppression of crimes by convicts at large on license or by other offenders. This statute was, however, repealed by the 34 and 35 Vict. cap. cxii., which contains provisions for the more effectual prevention of crime. Any constable may, if authorized in writing by his chief officer, take into custody, without warrant, any convict who has a ticket of leave if there are any reasonable grounds for believing that the convict is getting his livelihood by dishonest means; and upon proof before a court of summary jurisdiction his ticket of leave or license is to be forfeited. A convict holding a license must notify his residence to the chief officer of police in the district. Criminals are to be registered and photographed. Persons twice convicted on indictment may be specially punished and subjected to police supervision. If any person is found in possession of stolen property evidence may be given and considered that there was found in the possession of such person other stolen property within the preceding period of twelve months.

HACKBERRY (*Celtis occidentalis*, natural order Urticaceæ), an American tree, with several varieties, occurring in woods and on river banks from New England to Wisconsin and southwards. The flowers are greenish and axillary; the fruit a globular drupe. The tree is small or middle-sized, with the aspect of an elm. The fruit is sweet and edible, as large as the bird-cherry, and ripening in autumn. The varieties are *C. pumila*, a low and straggling tree; and *C. crassifolia*, sometimes a tall tree; leaves thick, with a long tapering point; common southward and westward.

HACKMATACK, a term applied in many parts of the United States to the American larch. See LARCH.

HACKNEY, a municipal and parliamentary borough in the north-east of London, 3 miles N.N.E. of St. Paul's. There was here formerly a priory of the order of St. John of Jerusalem, and the Knights Templars had a manor and mills here. There is a modern town-hall, a very fine building. Hackney was formerly noted for its boarding-schools for young ladies. It is supposed that hackney-coaches were first established between this place and London, and derived their name from it. It has manufactories of chemicals, india-rubber, &c.; and had formerly extensive silk-mills. Since 1885 it returns three members to Parliament. Pop. (1891), 229,531; (1901), mun. bor. 219,288; parl. bor. 253,215.

HACKNEY COACH, a coach let out for hire. Hackney coaches began first to ply under this name in London in 1625, when they were twenty in number. The laws relating to the drivers of hackney coaches differ little from those applying to other public carriers. Hackney coachmen are generally put under police regulations in all towns of the kingdom, and a tariff of fares imposed on them. They require a license from the town-council or similar body, and must conform to the regulations laid down by this authority. The usual fare is 6*d*. a mile. Hackney coaches are now usually known as cabs.

HADDINGTON, a royal (formerly a parl.) burgh and market town of Scotland, capital of the county of same name, on a branch of the North British Railway, 17 miles east by north of Edinburgh, on the Tyne, by which it is separated from the suburb of Nungate, the communication being maintained by a bridge of three arches. The town consists of four streets, which intersect each other at nearly right angles, lined with handsome and well-stocked shops, and having in the suburbs some handsome and commodious villas. It has a town-house, a fine structure, surmounted by a spire 150 feet high, in which is a clock with illuminated dials. There are handsome county buildings, which include the sheriff court-room, a new prison, &c. There is a Gothic church of the eleventh or twelfth century, surmounted by a square tower 90 feet high; this building has long been partly in a ruinous state, but extensive restorations have been carried out especially

on the nave, which forms the parish church. The other buildings of note are the Knox Memorial Institute, which now includes the old grammar-school; the spacious corn exchange, &c. There are several religious and benevolent societies, a free town library, and an agricultural and horticultural society. The chief trade of Haddington arises from its corn-market, held on Fridays—next to that of Dalkeith the most important in Scotland. In the town is a brewery, and there are also here large malting premises, some considerable iron-foundries, coach and implement works, tanneries, corn-mills, &c.

Alexander II., king of Scotland, was born in the Palace of Haddington, the former site of which is now occupied by the county hall. Haddington lays just claim to have been the birthplace of the Scottish reformer John Knox. Prior to 1885 it united with North Berwick, Dunbar, Lauder, and Jedburgh in sending a member to the House of Commons. Pop. in 1881, 4043; in 1891, 3770; in 1901, 3992.

HADDINGTONSHIRE, or EAST LOTHIAN, a beautiful maritime county in the south-east of Scotland, bounded on the north and north-west by the Firth of Forth, on the north-east and east by the German Ocean, south by Berwickshire, and west by Edinburghshire or Mid-Lothian. Its greatest length from east to west is about 27 miles; its breadth from north to south is 15 miles; area, 268 square miles, or 171,377 statute acres, of which four-fifths are arable or fit for cultivation. The surface rises gently though not uniformly from the coast towards the Lammermuir Hills, 500 to 1700 feet high, which form its south boundary. There is a ridge on the north side of the town of Haddington running east and west for about 3 miles, between which and the Firth of Forth is a fertile plain, relieved only by a sandy ridge at Gullane and the beautiful North Berwick Law, rising like a cone 800 feet above the level of the sea. The county is divided into two nearly equal portions by the river Tyne, which, rising in Mid-Lothian, enters Haddington in the south-west, and discharges itself into the sea at Tyninghame on the north-east. There are several other streams of less size, which either join the Tyne or otherwise discharge into the sea. The old red sandstone forms a considerable portion of this county, generally resting on metamorphic rocks, covered by the coal formation. Coal, limestone, clay or blackband ironstone, clay and sandstone—the former suitable for brick-making, and the latter for building—abound; and there are several whinstone quarries, producing excellent material for road-making. Red hæmatite of a very pure quality was discovered in 1866, about a mile north of Haddington, and was worked for some years successfully by the Coltness Company. It exists, though in uncertain quantity, in other parts of the county. The climate, though healthy, is so extremely various that harvest is sometimes nearly a month later in one part of the county than another. Haddingtonshire is an entirely agricultural district, and has been long celebrated for the skill and success with which its husbandry has been conducted. Along the coast the soil is a rich, light, reddish loam; it gradually varies to clay towards the upper districts, and its general character is that of a clay bottom. The lower grounds are not surpassed in point of productiveness by many places in the kingdom. The principal crops are wheat and barley. Potatoes also are very extensively cultivated; and turnips attain a perfection here which they reach almost nowhere else in the United Kingdom. Sheep are bred, but not to any great extent, except on the Lammermuir Hills. Fattening stock of all descriptions constitutes a part of the economy of every well-managed farm. With the exception of an extensive paper work at West Barns, near Dunbar, there are no manufactories of any importance, though there are several breweries, potteries, foundries, and implement works. The county sends a member to Parliament. Pop. in 1871, 37,771; in 1881, 38,502; in 1891, 37,491; in 1901, 38,653.

HADDOCK (*Morrhua æglefinus*). This fish appears in such shoals as to cover a tract of many miles, keeping near the shore. In stormy weather they will not take the bait. The fishermen assert that they then bury themselves in the mud, and thus shelter themselves till the agitation of the water has ceased. In proof of this they allege that those which are taken immediately after a storm are covered with mud upon the back. It has a brown back, a silvery belly, and a black lateral line. On each side, about the middle, is a large black spot, the prints, as is superstitiously believed, of the finger and thumb of St. Peter, when he took the tribute-money from its mouth; but, unfortunately, the haddock is not the only fish thus distinguished, nor does it live in fresh waters, such as the Sea of Tiberias. It spawns in February and March. The ova have been found floating in the North Atlantic; and there is reason to believe that the hatching takes place at a distance from land The haddock commonly weighs from 2 to 4 lbs; sometimes as high as 10 It is caught with long lines and hand-lines, and in some parts by trawling. The haddock belongs to the family Gadidæ, which includes also the cod, ling, hake, torsk, whiting, &c.

A popular method of curing the haddock in Scotland is to cleanse it, steep it for a short time in brine, and smoke it over a wood fire. This method of curing the haddock was first practised in the village of Findon, Kincardineshire, and the fish so prepared are hence called 'Finnan' haddocks. A very considerable traffic is now carried on with this commodity between the fishing villages of the north and the cities of Edinburgh, Glasgow, and London. When properly prepared, it forms an agreeable relish to breakfast.

Haddock is also applied to two other fishes, the bergylt or Norway haddock, one of the Perch tribe, and the common sea-bream (*Pagellus centrodontus*), a sparoid species, in both of which lateral black patches occur.

HADERSLEBEN (Danish, *Hadersler*), a town, Prussia, in the province of Schleswig-Holstein, in a valley, where the Hadersleben Damm communicates by a small stream with the Hadersleben Fiord, in the Little Belt. It consists of an old and a new town; contains three churches, a gymnasium, and a well-endowed hospital; and has iron-foundries, machine-works, a tobacco factory, and a trade in corn, spirits, and cheese. The harbour is suitable only for small vessels. Pop. (1900), 9201.

HADES (Greek) means strictly *what is out of sight*, or possibly, if applied to a person, *what puts out of sight*. In earlier Greek this last was, if not its only, at least its prevailing application; in Homer it occurs only as the personal designation of Pluto, the lord of the invisible world, who was probably so designated from his power to render mortals invisible. The Greeks in process of time, however, abandoned this use of Hades, and when the Greek Scriptures were written the word was scarcely ever applied except to the place of the departed. In the Greek version of the Old Testament it is the common rendering for the Hebrew *Sheol*, and this rendering may be taken as evidence that there was a substantial agreement in the idea conveyed by the two terms as currently understood by the Greeks and Hebrews respectively. Two or three points stand prominently out in the views

entertained by the ancients respecting Hades: first, that it was the *common* receptacle of departed spirits, of good as well as bad; second, that it was divided into two compartments—the one containing an Elysium of bliss for the good, the other a Tartarus of woe for the wicked; and thirdly, that in respect to its locality it lay underground, in the mid regions of the earth. There was one important point of difference between the Jewish and the heathen Hades, which originated from the diverse spirit of the two religions. To the Hebrew the sojourn in Sheol appeared that only of a temporary and intermediate existence, closed by the bright resurrection morn; but the heathen had no prospects beyond its shadowy realms; and the idea of a resurrection was strange alike to his religion and his philosophy. The ideas on this subject were greatly modified by the teachings of Christ and the apostles. Hades was henceforth appropriated both in the name and in the reality to those who were to be reserved in darkness and misery to the judgment of the great day; and other names, such as paradise, Abraham's bosom, with other and brighter ideas, were employed to designate the intermediate resting-place of the redeemed.

HADJ, the Mohammedan pilgrimage to Mecca and Medina; whence *Hadji*, one who has performed this pilgrimage, and *Hedjaz*, the holy land where these cities are situated. The most complete and authentic accounts of the pilgrimage are those of Burckhardt, who performed it in the guise of a Mohammedan in 1814; and of Burton, who performed it as a wandering dervish in 1853 (Personal Narrative of a Pilgrimage to El-Medinah and Meccah, by R. F. Burton; London, 1855–56, three vols.) It was a custom long anterior to the introduction of Islamism, the famous 'black stone' of the Caaba at Mecca being then the object of veneration. See ARAFAT.

HADLEY, JOHN, inventor of the quadrant that goes by his name, was born in Hertfordshire on April 16, 1682. In 1717 he became a member of the Royal Society, and several valuable papers by him are published in their Transactions. Maitland, in his History of London, styles him a great master of hydraulics, having made many improvements in the machinery of the water-works at the Old London Bridge. But whatever may have been his talents as an engineer he is best known as the inventor of the instrument above alluded to, for measuring the angles of celestial objects at sea. His claim to the merit of the invention of the quadrant, or rather octant, which measures angles by double reflection, has been disputed by the Americans, who attribute it to Mr. Godfrey, of Philadelphia. Both Hadley and Godfrey produced their instruments in 1731; but it is highly probable that Hadley had completed his instrument some time before this, as he was on terms of intimacy with Newton, who many years ere this had conceived the idea of measuring angles by double reflection, as appears by his posthumous works. The Royal Society decided that Godfrey and Hadley were both entitled to the honour of the invention, and accordingly each received a reward of £200. The quadrant was soon afterwards superseded by the sextant. Hadley died 14th February, 1744.

HADRAMAUT, or HADHRAMAT, a division of South Arabia, bounded W. by Yemen, N. by the great desert of El Ahkaf or the billows of sand, N.E. by Omân, and S.E. by the ocean. It is evidently the Hazarmaveth of Scripture (Gen. x. 26), peopled by the posterity of Joktan (Yoktan or Kahtan). The name Hadramaut is an ancient territorial appellation—the connection of which with the political divisions of the country has long since passed away; and at the present day its application is confined to narrower limits than those which, on the authority of Arab geographers, have been stated above. Mahrah, or the country of the Mahrí, extending from Keshín north-east along the coast, is no longer included in it; and the limits of modern Hadramaut along the coast, though limits in Arabia are nowhere fixed with precision, may be said to be, west, the Bay of Ghubbet-Ain, lon. 48° E.; and east, Sihút, lon. 51° 20′. Thus limited, Hadramaut has, on the seashore, a length of about 200 miles; but there are some who restrict the name to a tract extending only about 60 miles in length, from Makallah eastward. The interior extent of the country is not so easily defined; but there is reason to believe that the elevated tract, embracing the habitable valleys, and separating the Desert of Ahkaf from the sea, has a breadth of about 120 miles. Immediately behind the coast rises a chain of mountains which reaches a height of from 4000 to 6000 feet. The hills near the sea are of limestone, but the main range is probably granitic; farther in the interior, probably from 60 to 70 miles in a straight line from the coast, commences a table-land 8000 feet in height, and covered with fine sandstone. It is in the valleys and glens of this plateau that the fertile spots are to be found which may be presumed to have given rise to the early celebrity of Hadramaut. The most important of these valleys is Wadi-Doom, 30 geographical miles in length, and from 5 to 6 in breadth. On the slopes of the mountains towns and villages rise contiguously in the form of an amphitheatre; and grain crops, dates, bananas, melons, cucumbers, indigo are extensively cultivated. Several other valleys or wadis open into it, intersecting the elevated land in many directions, and all containing villages and cultivated fields. The only place of any note on the coast of Hadramaut is Makallah, which is indeed the chief commercial depôt of the south coast of Arabia. The inhabitants, Hadarémí, of the present day, retain many traces of their ancient industry and civilization. Like their ancestors, the Chatramotitæ or Chatramonitæ of Greek and Roman writers, they are still renowned for courage, as well as for commercial enterprise. Hadramaut exports frankincense, myrrh, aloes, and dragon's-blood. The region is under the rule of several independent sultans.

HADRIAN. See ADRIAN.

HÆMATIN, a colouring matter which does not exist as such in the blood, but is a product of decomposition of hæmoglobin, the true blood colour; it has been found, however, as a pathological substance. It can be prepared either from pure hæmoglobin, or from defibrinated blood. From the latter it is got by digestion with powdered carbonate of potassium, washing the coagulum with a strong solution of the same, drying it in thin layers on glass plates, powdering the brown mass, boiling with strong alcohol, filtering, adding tartaric acid, decanting from the potassic tartrate which separates, and then concentrating. On cooling, a deposit of the hydrochloride of hæmatin forms, and this is washed with alcohol and then with water. From this the hæmatin is got by addition of ammonia, digestion in water to remove the ammonia salt, and filtering. The hæmatin remains as an amorphous blue-black body, with metallic lustre, which becomes reddish when powdered. It contains iron, and the formula assigned to it recently is $C_{68}H_{70}N_8Fe_2O_{10}$. When heated in the air it carbonizes, and ultimately burns away, leaving however the iron in the form of oxide, amounting to 12·6 per cent. Hæmatin is insoluble in water, in alcohol, and in ether, but dissolves readily in acids and in alkalies; the alkaline solution is brownish red

by reflected light, but by transmitted is dark green in thin layers, dark red in thick layers. Hæmatin is distinguished by its absorptive power for certain rays of light; but the absorption bands vary in position and intensity with the character of the solution, and by the action of certain reagents. The body called hæmin, or Teichmann's hæmin, or blood crystals, is the hydrochloride of hæmatin mentioned above. These crystals are readily got by treating defibrinated blood with common salt and strong acetic acid. If a drop of the solution be allowed to evaporate on a microscope slide crystals of Teichmann's hæmin will soon appear; these crystals form a characteristic and very delicate test for the presence of blood in a fluid. The preparation of the substance on the large scale is a troublesome and complicated operation. It forms a silky, metallic, blue-black, crystalline powder, quite insoluble in water, in alcohol, and ether, but very readily in alkalies. When treated with sulphuric acid hydrochloric acid is evolved; and the chlorine is also precipitated by silver, so that the crystals really consist of a compound of hæmatin and hydrochloric acid.

HÆMATITE, RED and BROWN. See IRON (ORES OF).

HÆMATOXYLIN ($C_{16}H_{14}O_6$), the colouring matter of logwood, or *Hæmatoxylon Campechianum*, got from the extract by allowing it to stand some days in contact with ether, decanting, removing the ether, and adding water. Hæmatoxylin gradually deposits, and the crystals by pressure and recrystallization can be got nearly colourless. Combined with three molecules of water it forms dimetric, with one of water trimetric crystals. The crystals are large, transparent, and brilliant, and have a sweet taste. Hæmatoxylin dissolves sparingly in water, but it is taken up very freely by solution of borax, by hyposulphite of sodium, phosphate of sodium, and some other salts. It is also soluble in ether and in alcohol. By acids it is not readily affected, but it reacts at once with alkalies, forming coloured solutions, and with metallic oxides forming precipitates of various colours. By joint action of air and bases hæmatoxylin is oxidized and becomes hæmateic acid.

HÆMORRHAGE. See HEMORRHAGE.

HÆMORRHOIDS. See HEMORRHOIDS.

HÆMUS, in ancient geography, a chain of mountains running eastwardly from the ancient Orbelus to the Pontus Euxinus, and separating Mœsia from Thrace. It terminated in a cape on the Black Sea, called *Hæmi Extrema*, at present *Emineh Dagh*. The modern name of the Hæmus is *Balkan*. (See BALKAN.) Fable derives this name from Hæmus, king of Thrace, who, considering himself equal to Zeus, was changed with his wife, who compared herself to Hera, into this mountain.

HAFIZ, MOHAMMED SHEMS ED DÍN, one of the most celebrated and most charming poets of Persia, was born at Shiraz in the beginning of the fourteenth century; studied theology and law, sciences which, in Mohammedan countries, are intimately connected with each other. The surname Hafiz was given him because he knew the Koran by heart. He was also called *Chekerleb* (Sugar-lip), from the flowing melody of his ghazels or short lyrics; and *Lissan Elghaïb* (the Mysterious Voice), from the deep mystic meaning said by his warmest admirers to be contained in many of his poems. He preferred independent poverty as a dervish to a life at court, whither he was often invited by Sultan Ahmed, who earnestly pressed him to visit Bagdad. He became a sheik or chief of a fraternity of dervishes, and died at Shiraz in 1389 (other say 1391 or 1394), where a sepulchral monument was erected to him, which is still frequently visited by pious Moslems. Some idea of his style and sentiments may be obtained through the medium of translations. Sir William Jones published translations of two of his odes, which are extremely beautiful; besides which may be noticed Nott's Select Odes of Hafiz, translated into English Verse, with the Original Text (1787, 4to), and Hindley's Persian Lyrics, from the Divan-I-Hafiz, with Paraphrases in Verse and Prose (1800, 4to). The songs of Hafiz were collected into a *Divan* (a Persian word for a collection of poems) after his death, which was first published at Calcutta in 1791, and translated into German by the celebrated orientalist Hammer-Purgstall (two vols. Stuttgart, 1812–13). A complete English translation by H. W. Clarke appeared in 1891 (two vols.). A critical edition of the Persian text, with scholia, &c., was published by Hermann Brockhaus (Leipzig, 1854–61, three vols.). Hafiz is loud in praise of wine, love, and pleasure.

HAG (*Myxine*), a genus of cyclostomatous fishes with a smooth, eel-like body, from 12 to 15 inches long, with a long dorsal fin continued round the tail to the vent. The aperture of the mouth is perpendicularly oval, furnished with a single projecting hooked tooth above, and the tongue has a double recurved row of teeth on each side. Around the mouth are eight delicate barbules, which are evidently intended as organs of touch. There are no eyes, and a double row of branchial cells take the place of gills or lungs, and are supplied with water through a spiracle in the upper part of the head, and two little apertures on the under surface. The vertebral column is a mere cartilaginous fibre, and there are no bones. The colour is dark brown above, grayish yellow below. The common glutinous hag, *Myxine glutinosa*, derives its specific name from the enormous quantity of viscid mucus secreted by the cutaneous glands, whose pores open along the under surface of the body; a single individual that was placed in a quantity of water equal to from 2 to 3 cubic feet was found to fill it with this slime so entirely that the whole could be lifted out with a stick in a single sheet. It is found along the coast of Great Britain and the northern seas of Europe. The fishermen have good reason to detest the hag, for it takes advantage of the helpless state in which the cod, ling, or haddock hangs from the hook, makes its way into the interior by the mouth or gills, and if the fish should hang for a tide after being caught, will leave little else than the skeleton and skin. The fish thus hollowed out are called 'robbed' fishes. Where the victim has been long left to these destructive creatures, no less than twenty of them have been found within the body. The hag is so remarkably worm-like in its form and general appearance that it was classed by Linnæus among the Vermes (worms), and was only placed in its proper position after careful dissection.

HAGAR, an Egyptian slave in Abranam's house. This, her Semitic name (the Egyptian is unknown), has been derived from various roots, and has been translated accordingly 'slender,' 'flight,' 'stranger.' She was presented by her mistress Sarah to Abraham, in order that Abraham might not die without descendants, Sarah herself being barren. Hagar bore Ishmael; but Sarah soon became jealous of her, and treated her severely. Hagar fled, but afterwards returned, and when Sarah bore Issac, was sent away by Abraham, who, the Bible informs us, had received a divine order to dismiss her. She suffered much distress in the desert, but was relieved by an angel, and married her son to an Egyptian woman. In the Mohammedan tradition Hagar (Hajir or Hágir) is represented as the wife of Abraham, as might be expected when we remember that Ishmael is the head of the Arab nation and the reputed ancestor of

Mohammed. She is also said to have dwelt and been buried at Mecca; and the well Zemzem, in the sacred inclosure of the temple there, is pointed out as the well which was miraculously formed for Ishmael in the wilderness.

HAGEDORN, Friedrich von, a German poet, was born in Hamburg in 1708. He received a good education, and displayed talents for poetry when young; but becoming an orphan at the age of fourteen, he found himself dependent on his own exertions for support. He, however, continued studying in the gymnasium at Hamburg till 1726, when he removed to the university at Jena, as a law student. In 1729 he published a small collection of poems; and the same year he went to London in the suite of the Danish ambassador, with whom he resided till 1731. He obtained, in 1733, the appointment of secretary to the English factory at Hamburg, which placed him in easy circumstances. It was not till 1738 that he again appeared before the public as an author, when he printed the first book of his Fables, which were much admired. In 1740 he published the Man of Letters, and in 1743 his celebrated poem on Happiness, which established his reputation as a moral writer. The second book of his Fables appeared in 1750; and he afterwards produced many lyric pieces in the style of Prior He died of dropsy in 1754. Wieland, in the preface to his poetical works, terms him the *German Horace*. The best edition of his poetical works was published in Hamburg in 1800, in five volumes, with a biography and critique by Eschenburg.

HAGEN, a thriving manufacturing town of Prussia, in Westphalia, government of and 25 miles west of Arnsberg, capital of circle of same name, at the confluence of the Volme and Ennepe. It has several churches (one of them Old Catholic) and a synagogue. Its industrial establishments include iron and steel works, puddling works, rolling-mills, foundries, tinplate works, manufactures of woollen, linen, and cotton cloth, leather, hats, &c. Near it is an alabaster quarry, a celebrated medicinal spring, and a stalactite cavern. Pop. (1900), 62,935.

HAGENAU, a town of Germany, Lower Alsace, 18 miles north of Strasburg, in the forest of Hagenau, on the Moder, which here divides into two branches, one of which traverses the town, while the other bathes it on the south. It contains several fine churches, in particular a Romanesque of the 12th century, and a Gothic of the 13th, a synagogue, cavalry barracks, and civil and military hospitals; has extensive manufactures of woollen and cotton goods, earthenware, &c.; a trade in hops, grain, timber, &c. Pop. (1900), 17,968.

HAGERSTOWN, a town, United States, capital of the county of Washington, Maryland, near the west bank of the Antietam Creek, 86 miles west of Baltimore. It has manufactures of agricultural implements and other goods, and considerable trade. The town is well built. Pop. (1900), 13,591.

HAGGAI, the tenth in order of the minor prophets, and first of those who prophesied after the captivity. Rabbinical tradition represents him as having been born in Babylon, and as having joined the first band of exiles who, on the issue of the decree of Cyrus (536 B.C.), returned to their own land. He was buried, according to some authorities, among the priests at Jerusalem, in which case he must have belonged to the family of Aaron. The book of Haggai consists of four distinct prophetical addresses—two in the first and two in the second chapter—and it has respect throughout to but one theme, the building of the second temple. The brevity of the several prophecies is so great, and the poverty of expression which characterizes them so striking, as to give rise to an idea that in their present form they are but the outline or summary of the original discourses. They were delivered in the second year of Darius Hystaspes (520 B.C.), at intervals from the first day of the sixth month to the twenty-fourth day of the ninth month in the same year. The closing prediction foreshadows the establishment of the Messianic kingdom upon the overthrow of the thrones of the nations.

HAGIOGRAPHA (Greek, holy writings). The Jews divide the Old Testament into three parts: 1, the law, which comprehends the five books of Moses; 2, the prophets; and 3, the writings termed by them *Cetubim*, and by the Greeks *Hagiographa*, whence the word has been introduced into the English language. They comprehend the Psalms, Proverbs, Song of Solomon, Job, Daniel, Ezra, Nehemiah, Chronicles, Ruth, Lamentations, Ecclesiastes, and Esther. The Hagiographa were distinguished from the prophecies because the matter contained in them was not received by the way of prophecy, but simply by the direction of the Spirit.

HAGUE, The (Dutch, *'S Gravenhage*—the Count's Hedge, *Hage*, or *den Haag;* German, *Haag;* French, *La Haye*), one of the chief towns of Holland, practically, though not formally, the capital of the kingdom, 33 miles south-west from Amsterdam, 16 miles north-west of Rotterdam, on the railway thence to Leyden, within 3 miles of the sea. It is the residence of the queen and of the foreign ambassadors, and the seat of the States-general of the Netherlands, and of the principal part of the central administration of the kingdom. It is pleasantly situated, defended from the sea-winds on the one side by lofty dunes, and on the others surrounded by fine arable or meadow land, or by a thick shady wood. It is in the form of an irregular quadrangle; and for width and straightness of streets, and general elegance of public buildings, will stand comparison with most continental towns. Among the most important structures are the royal palace, in the Nordeinde, the palace of the Prince of Orange, the palace of Prince Frederick of the Netherlands, a plain, neat house; the Binnenhof, a large irregular building, in various styles, on the Vijver (or Pond), founded in 1249, and containing the hall of assembly of the states-general, and various government offices; the provincial government-house, a large roomy edifice; the town-hall, a picturesque building, recently enlarged and restored; the ministry of justice; the municipal museum, containing pictures and antiquities; the royal library (300,000 vols.), with collections of coins, gems, &c.; a cannon-foundry, one of the largest and most conspicuous buildings in the town, colonial office, war office, national monument, &c. The royal collection of pictures, in the Prins Mauritshuis, embraces a picture-gallery chiefly confined to Dutch masters, many of whose finest works are here. Among the most notable of the churches is that of St. James, founded in 1308, and distinguished for its lofty hexagonal tower, with a peal of thirty-eight bells. There is a large and beautiful park. Many of the inhabitants subsist from the traffic created by the presence of the court and the states-general, as well as of the strangers that come to the sea-bathing at the neighbouring village of Scheveningen; but considerable manufactures are likewise carried on, though the Hague cannot be called either a manufacturing or a commercial town. Scheveningen, which is about 3 miles distant, is now a favourite bathing-place, and a number of elegant villas and large hotels have been erected.

The origin of the Hague may be traced to the building of a hunting seat here of the counts of Holland in 1250; but it has risen into importance chiefly since the beginning of the nineteenth century, and

mainly through being made the residence of the court and the foreign ministers, and the seat of the states-general and the government. It is the birthplace of William II., Prince of Orange, and William III., prince of Orange and king of England; of Huyghens, and Boerhaave. Pop. in 1901, 218,029.

HAGUE CONFERENCE, a conference of all the chief powers of the world held at the Hague in May, June, and July, 1899, in response to a rescript issued by the authority of the Czar Nicholas II. in August, 1898. The rescript laid special emphasis on 'the terrible and increasing burden of European armaments', and recommended for careful consideration the questions of 'the maintenance of general peace, and a possible reduction of armaments'. The final Act of the Conference consists of three conventions: the first for the pacific settlement of international disputes; the second concerning the laws and customs of war on land; and the third for the adaptation to naval warfare of the principles of the Geneva Convention of 1864; besides declarations against the throwing of projectiles and explosives from balloons, against the use of projectiles intended solely to diffuse deleterious gases, and against the use of expanding bullets. The most important of the conventions is the first, under which a permanent court of arbitration has been established at the Hague. This court consists of representatives 'of recognized competence in questions of international law' appointed by each signatory power, and any signatory powers desiring arbitration may choose any number of its members to act as arbitrators. Non-signatory powers may make use of the court under prescribed conditions. This convention also provides a definite machinery for good offices and mediation. The three conventions and the three declarations were ratified by Austria-Hungary, Belgium, Bulgaria, Denmark, France, Germany, Italy, Netherlands, Persia, Roumania, Russia, Siam, and Spain. Great Britain ratified the conventions.

HAHNEMANN, SAMUEL CHRISTIAN FRIEDRICH, the founder of the homœopathic system, born at Meissen in 1755, attended the Prince school there, and in 1775 went to Leipzig, where, against his father's will, he studied medicine, and found the means chiefly by the translation of English Medical works. At a later period he went to Vienna, and from thence to Hermannstadt as private surgeon and librarian to Baron von Brückenthal, governor of Transylvania. After some years he returned to Germany, and having completed his studies at Erlangen, took his degree there in 1779. He afterwards practised medicine at various places, but gave it up for a time, until, in 1789, by the translation of Cullen's Materia Medica, he was led to adopt a new method of cure. His system was fully explained in his Organon der rationellen Heilkunde (Dresden, 1810). In 1820 the government prohibited him from dispensing medicines, and thereby, from his inability to have them prepared by druggists, obliged him to give up his practice. Duke Ferdinand of Anhalt-Köthen, however, gave him an asylum at Köthen, and conferred upon him the title of Hofrath. Here he remained till 1833, when he married a young French lady for his second wife, and proceeded to Paris, where he hoped to find a wider sphere for his operations. The result equalled his expectations; and a royal degree issued in 1835 authorized him to practise homœopathy. He died at Paris in 1843. Among his works notice is due to his Dictionary of Materia Medica, his Essays on Poisoning by Arsenic, and on the Effects of Coffee, and his treatise on Chronic Affections.

HAIDUCKS (Hungarian, *hajduk*, drovers), a term originally applied to the herdsmen of Hungary, and afterwards to the bands of Magyar foot-soldiers, who placed themselves at the service of any potentate who was willing and able to pay them. Their fidelity to the cause of Bocskay in the war of Succession was rewarded by a grant from that prince, in 1605, of a separate district of the country for their residence, which was exempted from most of the burdens of the rest of the kingdom. He at same time accorded them all the privileges of nobility. The Haiducks continued till 1848 to enjoy all their ancient privileges with the exception of exemption from taxes. The comitat or county of Haidücken or Hajdu was formed in 1876 out of the former Haidücken district and parts of the neighbouring counties of Szabolcs and Bihar. It has an area of 1294 square miles, and a population (1890) of 190,978. The capital is Debreczin. The name Haiducks has also been applied to the Hungarian constabulary force, and to the military guard and lackeys of the Austrian and some German courts.

HAIL, small masses of ice or frozen rain falling from the clouds in showers or storms, varying in their form, being either angular, pyramidal, or stellated; as well as in their consistency, being sometimes as hard as ice and sometimes as soft as snow. Properly there are two kinds of hail, one of them (Fr. *grésil*, Ger. *Graupeln*) occurring, at least in warm climates, most during spring or autumn; the other (Fr. *grêle*, Ger. *Hagel*) almost confined to the summer months in the warmer regions of the globe. The first of these, known sometimes as soft hail, seems to be essentially intermediate between snow and true or hard hail. Its grains are small, and often fall along with or just before snow, and it is generally accompanied by wind. The structure and forms of hail are various, but there is generally at the centre an opaque spongy mass, resembling sleet in its composition, and round this a semi-transparent congealed mass is formed. This mass consists sometimes of a succession of layers or strata, varying in their degrees of transparency. Fig. 21 in the plate at SNOW represents a hailstone which fell at Bonn in 1822. It displays a singular stellular arrangement of the congealed particles round the central nucleus. Figs. 22 and 23 are sections of hailstones which fell on the same occasion. Fig. 24 represents the section of one where the surface appears covered with minute pyramids. When any of these hailstones are burst asunder the result is the production of a number of pyramidal fragments, forming what is called pyramidal hail, as shown in figs. 25–28. The earliest theory of the formation of hail is that of Volta, who attempted to explain it by means of the mutual action of two electrified clouds, but his explanation is now rejected as inadequate. The more recent theory of Ferrel, according to which the formation of hail is dependent on the presence of whirlwind phenomena in the upper atmosphere, has gained considerable acceptance. The formation of the alternate coatings of ice and snow is, on this theory, produced by a series of vortical ascents and descents to and from an upper snow region and a lower region where the temperature is rather higher. The usual size of hailstones is about ½ inch in diameter, but they are frequently of much larger dimensions, sometimes even 3 or 4 inches in diameter. Severe hail-storms often do much damage to crops and other property.

HAILES, LORD. See DALRYMPLE (SIR DAVID).

HAINAN, an island of China, between the China Sea and the Gulf of Tonquin, and separated from the Peninsula of Liou-tchou by a channel of 15 miles, encumbered with shoals and coral reefs; length, 185 miles south-west to north-east; breadth, 90 miles.

The east coast is steep and rocky, the north-west low and lined with sand-banks, the south provided with several safe and spacious bays. The interior is traversed by an extensive mountain range, and is of little fertility, but the low lands near the coast are both fertile and well cultivated. The principal products are rice, sweet-potatoes, sugar, tobacco, drugs, dyes, wax, and timber. Among the minerals, gold and lapis lazuli have been found. The fisheries on the coast are productive, and employ great numbers of the inhabitants. The island is divided into thirteen districts, the respective towns of which are all on the coast. The capital is Kiung-chow, which, with its port Hoihow, 3 miles distant, is open to foreign trade, the exports being sugar, pigs, sesamum seeds, eggs, &c.; the imports cottons, woollens, kerosene, opium, &c. Pop. of the island estimated at 2,500,000.

HAINAUT, or HAINAULT, an ancient province, now forming part of the north-east of France and south-west of Belgium. In the time of Cæsar it was inhabited by the Nervii, a warlike people of German origin, and did not till the seventh century take the name of Hainaut, supposed to be derived from the small river Haine, which waters it. It was then governed by counts, who, however, were not regarded as hereditary till the time of one of them, called Regnier or Rainier Long Neck, who died in 916. The succession continued unbroken till 1436, when Jacqueline, the heiress of William IV., was forced to cede her territory to Philip the Good, duke of Burgundy. Through his successors it passed to the house of Austria, and afterwards became divided into two parts—Austrian-Hainaut or Hainaut proper, nearly corresponding with the Belgian province of that name; and French-Hainaut, ceded to the French by the treaties of the Pyrenees in 1659, and of Nijmegen in 1678; and now included in the department du Nord.

HAINAUT, or HAINAULT (Dutch, *Hennegouwen;* German, *Hennegau*), a south-western province of Belgium, bounded on the north by Brabant and the provinces of East and West Flanders, east by Namur, and south and west by France; area, 1437 square miles. Though nowhere properly mountainous, it is very hilly in the south-east, where it is covered by the Western Ardennes. In other directions it is generally flat, though well diversified. It belongs partly to the basin of the Scheldt, and partly to that of the Meuse—the former traversing its western corner, and also receiving some of its drainage through the Dendre; and the latter draining a considerable portion of the east by its tributary the Sambre. About three-fourths of the whole surface is arable, and scarcely a hundredth part is waste. The soil is generally fertile, and produces in abundance cereal and leguminous crops, fruit of various kinds, flax, hemp, hops, oleaginous seeds, tobacco, chicory, hay, and green food. The meadows and pastures maintain great numbers of horses and cattle —the former much valued for draught, and the latter for dairy produce. The forests, situated chiefly in the south, furnish large quantities of timber and fuel. The latter, however, is better furnished by the coal-mines, which are very productive and extensively worked, both for home consumption and export, chiefly to France. The other minerals include iron, marble, millstones, building-stone, and pavement. Manufactures are carried on to a great extent. Among others may be mentioned cutlery and all kinds of articles in iron, woollen and linen goods. For administrative purposes Hainaut is divided into six arrondissements—Mons, the capital; Tournai, Charleroi, Ath, Soignies, and Thuin, subdivided into thirty-two cantons. Pop (1899), 1,133,672.

HAINBURG, or HAIMBURG, a town, Lower Austria, beautifully situated on the left bank of the Danube, surrounded by vine-covered hills, 27 miles south-east of Vienna. It is walled; contains an old and also a fine new castle, to which Napoleon's sister, the wife of Murat, was permitted to retire after she had lost the crown of Naples; and an ancient town-house with a Roman altar; and has very extensive manufactures of tobacco and needles, and some shipping trade. Hainburg was nearly all burned down in 1827, and has since been rebuilt in an improved form. It is supposed by some to be the ancient Carnuntum. The old castle is the Heimburc of the Nibelungenlied. Pop. (1900), 6225.

HAINICHEN, a town, Saxony, circle of and 41 miles south-east of Leipzig, on the Little Striegitz. It is an old but stirring place, the chief seat of the flannel manufacture of Germany, and has worsted and other mills, bleachfields, &c. The poet Gellert was born here. Pop. (1890), 8259; (1900), 7932.

HAIR, the fine, threadlike, more or less elastic substance, of various form and colour, which constitutes the covering of the skin in the class of mammalia. The skin of invertebrated animals frequently supports structures which are called hairs; but the latter are properly developments from the true skin, the former are elongated cells or series of cells not developed in special connection with the true skin. In the crustaceous animals it sometimes appears in particular places, as the feet, on the margins of the shell, on the outside of the jaws, and grows in tufts, the hairs varying in form according to their function as touch organs. Hair is most distinctly developed in those insects—as caterpillars, spiders, bees, &c.—which have a soft skin; in this case it even appears of a feathery form, and butterflies are covered all over with a coat of woolly hair of the most variegated and beautiful colours. The same variety and brilliancy are displayed in the feathers of birds, which are homologous with hair, whilst the two other classes of animals—fishes and reptiles—have no hair, the scales replacing them. No species of mammalia is without hair in an adult state, not even the Cetacea. In quadrupeds it is of the most various conformation, from the finest wool to the quills of a porcupine or the bristles of the hog. The hair which is spread over almost the whole of the skin is comparatively short and soft. On particular parts a longer, thicker, and stronger kind is found; as, for instance, the mane, fetlocks, and tail of the horse, the lion's mane, the covering of man's occiput, his beard, the beard of goats. The colour of the hair generally affords an external characteristic of the species or variety; but climate, food, and age produce great changes in it. The human body is naturally covered with long hair only on a few parts; yet the parts which we should generally describe as destitute of it produce a fine, short, colourless, sometimes hardly perceptible hair. The only places entirely free from it are the palms of the hands and the soles of the feet; but the body of the male often produces hair like that of the head on the breast, shoulders, arms, &c. Each hair consists of a shaft and root. The latter is a bulbous expansion, which fits like a cap on a papilla of the true skin. This papilla is at the bottom of a follicle or pit into which the epidermis or scarf-skin extends. In fact the hair is derived from the epidermis, and is moulded on the papilla just as the feather of a bird or a tooth is moulded. The shaft is solid for the most part, air-cells being found in light-coloured and white hairs. The colour of hair depends on pigment cells in the fibrous axis of the shaft. White hair is of two kinds; pure white from the absence of pigment, and bluish white when abundant air-cells refract the light, the latter tint being

found in such cases as resume the original colour after a temporary whiteness. The colour of the hair is a race character; and the shape of the shaft has likewise been used in this way, transverse sections showing circular, oval, flat, or reniform outlines.

The human hair varies according to age, sex, country, and circumstances. The fœtus has, in the fifth month, a fine hairy covering, which is shed soon after birth, and appears again at the age of puberty. With the seventh month the first traces of hair on the head are visible in the embryo. At birth an infant generally has light hair. It always grows darker and stiffer with age. The same is the case with the eyelashes and eyebrows. At the age of puberty the hair grows in the armpits, &c., of both sexes, and on the chin of the male. At a later period it begins gradually to lose its moisture and pliability, and finally turns gray or falls out. These effects are produced by the scanty supply of the moisture above-mentioned, and a mortification of the root. But age is not the only cause of this change; dissipation, grief, anxiety, sometimes turn the hair gray in a very short time. It begins to fall out on the top of the head. The hair of men is stronger and stiffer; that of females longer (even in a state of nature), thicker, and not so liable to be shed.

Blumenbach adopts the following national differences of hair:—1, brown or chestnut, sometimes approaching yellow, sometimes black, soft, full, waving; this is the hair of most nations of Central Europe; 2, black, stiff, straight, and thin, the hair of the Mongolian and native American races; 3, black, soft, curly, thick, and full hair; common in the South Sea Islands; 4, black, curly wool, belonging to the negro race. See ETHNOLOGY.

The hair, with the nails, hoofs, horns, &c., is one of the lower productions of animal life. Hence in a healthy state it is insensible, and the pain which we feel when hairs are pulled out arises from the nerves which surround the root. It grows again after being cut, and, like plants, grows the more rapidly if the nutritive matter is drawn to the skin by cutting; yet, in a diseased state, and particularly in the disease called the *plica Polonica*, it becomes sensitive and inflamed to a certain degree, bleeds, and is clotted by a secretion of lymph, which coagulates into large lumps.

Hair not only serves as a cover or ornament to the body, but exercises an important influence on absorption and perspiration; where the hair is thick the perspiration is freer. If the root is destroyed there is no means of reproducing the hair; but if it falls out without the root being destroyed, as is often the case after nervous fevers, the hair grows out again of itself. If the skin of the head is very dry and scurfy, mollifying means will be of service; strengthening ointments should be applied in case the skin is weak. This shows how little reason there is in recommending oils in all cases, while the falling out of the hair may be owing to very different causes. Though hair, in a healthy state, grows only on the external parts of the body, cases are not unfrequent in which it is formed inside of the body in diseased parts. How much the hair differs in its character from the other parts of the body (being, as we have said, of a vegetable nature) is strikingly shown from the circumstance that it continues to grow after death.

HAIR, COMPOSITION OF. This is a subject upon which a great deal of research has been spent, but with very indefinite results. The ultimate constituents of hair are carbon, hydrogen, nitrogen, oxygen, and sulphur, with inorganic salts consisting of sulphates of sodium, potassium, and calcium, carbonates of magnesium, calcium, and sodium, common salt, phosphate of calcium, oxide of iron, and silica. The silica amounts sometimes to 40 per cent., the phosphate to 20, the sulphate of sodium to 30. The organic matter of the hair is a mixture, but after treatment with water, with alcohol, and ether, a substance called *keratin* remains which is possibly the same whether derived from hair of different kinds, or horn or other epidermal appendages. The ultimate analysis of this substance, however, shows discrepancies which make it probable that keratin is really a mixture. The only constituent of hair which seems to be tolerably uniform is the sulphur, which amounts to a little above 4 per cent. in hair of either sex and of every age and colour.

Under ordinary circumstances hair is a very stable substance. It is the last thing which decays,[1] and the identification of it is sometimes of great importance in medico-legal cases. For this purpose the microscope is the best test. Hair is not acted on by water, but heated in it under pressure it decomposes, evolves sulphuretted hydrogen, and dissolves; it is also dissolved by alkalies and acids. Solutions of silver and lead react with the sulphur in it and form the black sulphides, which being insoluble in water, form a permanent dye upon the hair. With regard to the natural colour of hair, great diversity of opinion prevails. Formerly it was ascribed to oily colours, but this has never been confirmed. One says it is due to a granular pigment, another traces a connection between the colour and the amount of iron, while a third ascribes it not to colouring matter at all, but to physical structure. When heated alone it hardens, emits an empyreumatic odour, catches fire and burns; but in close vessels ammoniacal liquor and fœtid oils distil over, as in the distillation of feathers and hart's-horn.

HAIR, MANUFACTURES OF. As an object of manufacture hair is of two kinds, the *curly* and the *straight*. The former, which is short, is spun into a cord, and boiled in this state, to give it the tortuous springy form. It is used principally for stuffing seats of chairs, sofas, &c. The long straight hair is woven into cloth for sieves and chair and couch bottoms. For this purpose the hair is dyed in the following way:—40 lbs. of tail-hair about 26 inches long are steeped for twelve hours in lime-water; a bath is then made with a decoction of 20 lbs. of logwood, kept boiling for three hours, after which the fire is withdrawn from the boiler, and 10 oz. of copperas are introduced, stirred about, and the hair, previously washed from the lime in river-water, is immersed, and allowed to remain for twenty-four hours. Hair used for weaving is obtained chiefly from South America and Russia. All colours are dyed black for covering furniture, except pure white, which is dyed so as to produce the fancy colours of the ornamental hair-cloths, which are greatly in request abroad. The quality of hair-cloth, as well as the brilliancy and permanency of the colours, depends in a great measure on the nature of the warp, which may be of cotton, worsted, or linen—oftenest the last. The looms for weaving hair differ very little from the common ones. The weft is thrown with a boxwood hooked shuttle, 3 feet in length, ½ inch broad, and ⅛th in depth. The weaver passes this shuttle between the threads of the warp with one hand when the shuttle-way is opened by the treddles; a child placed at one side of the loom presents a hair to the weaver near the selvedge, who catches it with the hook of the shuttle, and by drawing it out passes it through the warp. The hairs are placed in a bundle beside the child in a box filled with water, to keep them moist

[1] Specimens 1000 years old from Bolivia have given the average amount of sulphur.

and supple. Each time a hair is drawn across, the batten is driven home twice. The warp is dressed with paste in the usual way, and the cloth, when taken from the loom, is hot-calendered to give it lustre. The hand-loom for weaving hair-cloth may now be considered obsolete, however, being superseded by two or three varieties of power-loom, in which the hairs are picked up individually by an ingenious contrivance called a 'picker'.—*Brushes made of hair* are of various kinds: the stronger sort are made from the hair of swine, the wild-boar, &c. The best bristles come from Russia. The finer brushes (or hair-pencils) of the painters are made of the hair of the sable, the camel, the miniver, the martin, the badger, and the polecat, set into the quills of the goose, swan, duck, lapwing, pigeon, or lark.

HAIR-DRESSING. As the hair is the greatest ornament of the human body, the arrangement of it has always been one of the most important duties of the toilet. The ancient Hebrews esteemed fine hair a great beauty, as several passages of Scripture show; and baldness is even threatened as a sign of God's anger (Isa. iii. 17, 24). The Mosaic law gives rules respecting the hair (Leviticus, xix. 27). The Hebrew women plaited their hair, confined it with gold and silver pins, and adorned it with precious stones (Isa. iii. 22). The misfortune of Absalom shows that men also valued long fine hair highly (2 Sam. xiv. 26). Strong hair was considered a proof of strength, and means were used to strengthen it. Herodotus informs us that the ancient Egyptians let the hair of the head and beard grow only when they were in mourning. Even in the case of young children they were wont to shave the head, leaving only a few locks on the front, sides, and back. The women, however, wore their natural hair long and plaited, often reaching down in the form of strings to the bottom of the shoulder-blades. A practice the very opposite seems to have prevailed among the ancient Assyrians, as regards men at least. In the Assyrian sculptures the hair always appears long, combed closely down upon the head, and shedding itself in a mass of curls on the shoulders. The beard was also allowed to grow to its full length. To the Greeks the hair was an object of great importance, and they devoted much time to it. Homer regularly applies to the Greeks an epithet denoting that they had ample flowing locks. The custom of dedicating the hair to one of their deities, and shaving off some of their locks for that purpose, seems to have been general both with the men and women of ancient Greece. In Euripides, when Pentheus threatens to shave the hair of Bacchus, the young god tells him that the lock is sacred, as he preserves it as a choice votive offering for a god. Berenice made an offering of her locks to Ares (Mars) to insure victory to the arms of Ptolemy Euergetes. The Athenians curled their hair, and fastened it up with small golden ornaments shaped like grasshoppers, in token of their being 'sons of the earth'. Gold, pearls, precious stones, flowers, and ribbons were employed to ornament the tresses, and nets were also worn. False hair seems to have been latterly used, and in great quantities, both curled and frizzled. Married women were distinguished from the unmarried by the manner in which the hair was parted in front. In cases of intense grief or affliction the Greeks shaved the head: thus, Achilles had his hair cut off and thrown on the funeral pile of Patroclus. By the Romans baldness was looked upon as a deformity, and Cæsar is said to have prized the honour of wearing a laurel crown above all the other dignities conferred upon him, because it concealed his baldness. The Romans generally wore no covering on their heads except at sacred rites, games, festivals, and in war. Women in later times wore great quantities of false hair, and dyeing the hair was common. They were particularly addicted to frizzling and curling their hair, raising it into stories of curls, some of great height. Long hair-pins were used to fix the curls. Arranging the hair was a matter of great importance. Slaves frizzled and adjusted it, and a number of females learned in the art of the coiffeur superintended the process, while the fair dame herself watched the growing edifice of curls, gold, precious stones, crowns of flowers, in a mirror of polished steel, brass, tin, or silver. In the time of Ovid blonde hair was fashionable, and great quantities of it were imported from Germany. An embroidered or golden net was frequently used to inclose the hair. The ancient Germans, both men and women, wore their hair long, and the ancient Gauls were also proud of their long hair.

On the introduction of Christianity the apostles and fathers of the church preached against the prevailing fashion of dressing the hair. St. Paul regarded it as a shame for a man to have long hair, though the reverse for a woman. It then became common for men to cut the hair short; hence the clergy soon wore the hair quite short, and afterwards even shaved their heads in part. (See TONSURE.) There is a canon, dated 1096, which declares that all males who wear their hair long shall be excluded from the church while living, and not prayed for when dead. But even the excommunications fulminated in the middle ages against long hair and the extravagant ornamenting of it could not put a stop to the custom. It must be remembered that among the ancient Greeks and Romans cutting off the hair short was a great dishonour. Hence prisoners of war, and slaves who had committed some offence, had their heads shaved or hair cut. With the Lombards it was a punishment for theft under a certain small sum, and according to an old law of the Saxons for stealing three shillings in the daytime. Hence the former expression in Germany, *jurisdiction of the skin and hair*, that is, jurisdiction over minor offences, the highest punishment of which was flogging and cutting the hair. From the time of Clovis the French nobility wore short hair, but as they became less martial they allowed the hair to grow longer. In the time of Francis I., king of France, long hair was worn at court; but the king, proud of his wound on the head, himself wore short hair, in the Italian and Swiss fashion, which soon became general. In the reign of Louis XIII. the fashion of wearing long hair was revived, and as it became desirable to have the hair curling, the wigs were also restored.

Among the Anglo-Saxon women the custom prevailed of parting, curling, turning the hair over the back, &c. Anglo-Saxon men wore their hair long at the time of the Norman invasion, while the conquerors adopted the singular fashion of shaving the back of the head. In the reign of John the beaux are accused of curling their hair with irons, and binding it up with ribbons. Under Elizabeth, false hair was greatly worn, padded with cushions, under-propped, according to Stubbes, with forks, wires, &c., and adorned with gold, pearls, and precious stones. It is well known that the gallants of Charles I.'s time wore their hair in long flowing locks, while the closely-cropped hair of the Puritans brought the name of Roundheads down upon them. In the Queen Anne era, while the ladies wore their hair long, they generally tied it in a knot, and almostly completely covered it up by extravagant head-dresses of wire and paste-board, or feathers and ribbons. At that time, and for long after, the coiffure of a lady was such a serious affair,

and the hair-dressers were so fully employed, that fair wearers were often compelled to have that part of their toilet done two days before a ball, and pass the night on a chair for fear of disturbing the elaborate arrangement. A tax on hair-powder, which had been greatly in vogue for some time, along with the simplification of fashions consequent on the French revolution, not only expelled perukes and powder, but also brought the profession of hair-dresser within reasonable limits. A return was made to extravagance in this part of feminine toilet when the chignon was introduced and had its day of popular favour in the sixth decade of last century, bringing back the fashion of false hair and padding to a greater or less extent. With respect to men's hair, short cutting is now universal, long hair being considered as a sign of slovenliness or eccentricity.

HAIR-DYES. The practice of dyeing the hair is of great antiquity, and though not so common as formerly, it is still far from infrequent at the present day. The numerous preparations sold for this purpose have generally a basis of lead or silver. Bismuth, pyrogallic acid, and certain astringent vegetable juices, are occasionally thus employed. We subjoin two recipes. Nitrate of silver, 11 drams, nitric acid 1 dram, distilled water 1 pint, sap green 3 drams, gum arabic 1½ dram; digest together, and apply by means of a fine-toothed comb, or a half-worn tooth-brush, to the hair, previously well cleaned with soap and water, and dried. The most perfect mode of dyeing is to soak the hair well with a solution of sulphide of potassium; the stronger the solution the deeper the colour will be. When thoroughly wetted, the hair is allowed to dry partially, and is then well wetted with a solution of nitrate of silver, also proportioned in strength by the same rule as in the case of the solution first applied. This is a very permanent dye, which only requires renewing as the new growth of hair becomes conspicuous.

HAIR-GRASS (*Aira*), a genus of grasses belonging to that division of the order in which the spikelets have two or more florets, and the inflorescence is a loose panicle. The peculiar character consists in there being two florets present in each spikelet, with a third imperfect rudiment between them, and in the outer pale of each floret being rounded at the back, and furnished with an awn or beard. The *Tufted*, or *Turfy Hair-grass* (*Aira cæspitosa*), is a coarse fibrous-rooted perennial, forming great tufts, which, when in flower, are as much as a yard high. The leaves are harsh, rough at the edge, have a smooth sheath, and a long sharp-pointed ligule, which is often slit. The flowers form a large panicle, divided into a great number of horizontal, hair-like, elastic, rough branches, and are sometimes purple in colour. The awns of the florets are straight, and of the same length as the pale. The plant is common on moist, rich soils, especially in shady plantations, and in meadows. Its coarse, wiry herbage renders it disliked by cattle, which will not eat it if other food is within their reach. It is recommended for woods when covert is wanted for game, and where quality is of no consequence; but on cultivated ground it is a nuisance. For its extirpation thorough drainage is above all means to be recommended; but the digging out of the tufts and sowing other grasses on the spot is also practised, as well as paring and burning. This grass (the *winnlestrae* of the Scotch) is used as thatch for ricks, and in some places for making mats.

HAIR-POWDER, a preparation of pulverized starch and some perfume, formerly much used to whiten the head. Sometimes the powder was coloured. The custom of wearing it was introduced from France into England in the reign of Charles II., and is said to have originated from some of the ballad-singers of St. Germain's whitening their heads to render themselves more attractive. To make the powder hold, the hair was usually greased with pomade. In 1795 a tax was put upon the use of hair powder, and at one time yielded £20,000 per annum, but the result was that hair powder fell out of general use, and the French revolution, which overturned so many antiquated customs, further contributed to throw it into disfavour. It is now to be seen only on the heads of the footmen of some of our nobility; or occasionally on the heads of ladies and gentlemen at public and private fancy balls.

HAIR-WORMS. See NEMATELMIA.

HAITI. See HAYTI.

HAKE (*Gadus merlucius*, Linn.; *Merlucius vulgaris*, Cuv.) This fish belongs to that division of the Gadidæ which has two dorsal and one long anal fin. In shape it is not very unlike a pike, and has hence been termed the *sea-pike* by the French and Italians. The mouth is large, and is furnished with sharp teeth, those of the lower jaw being the larger. The back part of the tongue, the palate, and the throat are also armed with sharp spines or teeth. Hakes are very abundant in particular situations on the Irish coast; but after appearing for a number of years they seem to take a dislike to their accustomed haunts, and seek others. This is not peculiar to the hake, as the herring and various other fish are in the habit of relinquishing their stations for a considerable time, and then reappearing; and in most, but not all cases, the herring and hake appear and disappear together. The migration may in other instances be occasioned by the close pursuit of an unusual number of predatory fish, to avoid the voracity of which they may be driven upon shores that they were formerly unaccustomed to frequent; or a deficiency of some variety of food may force them to abandon a residence where they could no longer be supported.

HAKIM, a Turkish word, originally signifying *sage*, *philosopher*, and then, very naturally, a *physician*, as medicine and natural philosophy, among all nations in a low degree of civilization, are the same. *Hakim bashi* is the physician of the sultan, that is to say, the chief of the physicians, always a Turk; whilst the true physicians in the seraglio under him are western Europeans, Greeks, and Jews.

HAKLUYT, RICHARD, one of the earliest English collectors of voyages and maritime journals, was born about 1553. He entered Christ Church College, Oxford, in 1570, and became so eminent for his acquaintance with cosmography that he was appointed public lecturer on that science. In 1582 he published a small collection of voyages and discoveries, which formed the basis of a subsequent work on a larger scale. In 1584–88 he was in Paris as chaplain to Sir Edward Stafford. After his return he was chosen, by Sir Walter Raleigh, a member of the corporation of counsellors, assistants, and adventurers, to whom he assigned his patent for the prosecution of discoveries in America. He now prepared and published (in 1589) his famous collection of The Principal Navigations, Voyages, and Discoveries of the English Nation, made by Sea, or over Land, within the Compass of these 1500 Years. The first volume of a new edition of his great work was published in 1598, the second and third in 1599 and 1600. In 1602 he became prebendary, and in 1603 archdeacon, of Westminster, and next year he was appointed a chaplain of the Savoy. He died in 1616, and was interred in Westminster Abbey. He published several other geographical works; among them is Virginia Richly Valued, &c. (1609), a translation from the Portuguese. An edition of his chief work appeared in 16 vols. in 1885–90. The manuscript papers of Hakluyt were used by Purchas in his Pilgrims.

HAKODATE, or HAKODADI, a city of Japan, in the province of and about 40 miles from the city of Matsmai, near the south end of the island of Yesso, and in about lat. 42° N. It lies at the foot of a mountain upwards of 1000 feet in height, on the shore of a beautiful and spacious bay, which forms one of the best harbours in the world. Recently breakwaters have been constructed, and docks are being made. The town consists of rows of streets 30 to 40 feet in width, rising one above the other in lines parallel to the beach, and communicating with each other by cross streets. The houses are mostly of wood and two stories high, with fronts open to the street, and deep projecting eaves to keep off the rain and sun. There are many large temples in the city, some of them richly decorated, and numerous shops for the sale of fine silks and other goods. The export trade consists chiefly in timber, sea-weed, dried fish, sulphur, salt, and rice. Hakodate is one of the five Japanese ports opened to British commerce in 1858. It suffered severely by a fire in 1871. Pop. (1899), 90,131.

HAL, or HALLE, a town of Belgium, province of Brabant, on the Senne and the railway between Mons and Brussels, about 10 miles from the latter city, with a fine old church in the pointed Gothic style, a large and lofty town-house, manufactures of beet-root sugar, porcelain, chicory, soap, leather, and articles in wood and wicker work, breweries, distilleries, and oil-mills. Pop. (1897), 11,264.

HALBERD, or HALBERT, an offensive weapon, consisting of a pole or shaft about 6 feet long, having its head armed with a steel point edged on both sides. Near the head was a cross piece of steel somewhat in the form of an axe, with a spike or hook at the back. In Scandinavia and Germany this weapon dates from the earliest centuries of the present era; it was introduced into France by the Swiss in 1420. It was much used in the English army in the sixteenth century, and gave its name to troops called halberdiers, to whom was confided the defence of the colours, and other special duties. It is now rarely to be met with except in some Scotch burghs, where it is carried by the civic officers who attend the magistrates on public occasions.

HALBERSTADT, a town of Prussia, in the province of Saxony, 32 miles S.W. Magdeburg, capital of the circle of same name, in a fertile district, on the right bank of the Holzemme. It is a very ancient place, and has a number of the old-fashioned timber-framed houses, with the upper stories projecting over the lower, and curiously ornamented. The principal building is the Dom or cathedral, an ancient and interesting Gothic structure, erected mostly in the thirteenth and fourteenth centuries, with a fine interior, rich painted windows, beautiful Gothic choir-screen, numerous monuments, and a fine organ; the church of Our Lady, built in the Byzantine style, partly in the eleventh century, with curious bas-reliefs and wall paintings; several other churches, an old episcopal palace now the custom-house, a restored Gothic town-house (1360–81), municipal wine-cellar built in 1461, a fine wooden structure, theatre, monument of the war of 1870–71, gymnasium, normal and other schools, a deaf and dumb asylum, infirmary, &c. There are several extensive open areas in the town, the chief being that where the cathedral stands. The manufactures include gloves, refined sugar, leather, tobacco, paper, &c.; and there are breweries, distilleries, and extensive railway repair works. Halberstadt was in 804 the see of a bishop, and became the capital of a principality, which continued till 1807. Pop. (1900), 42,810.

HALCYON. See KINGFISHER.

HALE, SIR MATTHEW, an eminent English judge, was born at Alderley, in Gloucestershire, in 1609. He received his early education under a Puritanical clergyman, and afterwards became a student at Magdalen Hall, Oxford, whence he removed in his twenty-first year to Lincoln's Inn. He is said to have studied sixteen hours daily, extending his researches to natural philosophy, mathematics, history, and divinity, as well as the sciences more immediately connected with his profession. He was called to the bar previously to the commencement of the civil war; and in the conflict of parties which took place his moderation, accompanied as it was by personal integrity and skill in his profession, secured him the esteem of both royalists and parliamentarians in his own time. He acted as counsel for Archbishop Laud, and even offered his services as counsel to the king himself on his trial. In 1652 he was placed on the committee appointed to consider of the propriety of reforming the law. In 1654 he became a judge of the Common-bench (the former King's-bench), in which station he displayed firmness of principle sufficient to give offence to the Protector; and finding he could not retain his office with honour, he refused to preside again on criminal trials. After the death of Oliver Cromwell he refused a new commission from his son and successor. He was a member of the parliament which restored Charles II., and he was one of the members most active in passing the Act of Indemnity. In November, 1660, he was knighted, and made chief baron of the Court of Exchequer. He presided at the condemnation of some persons arraigned for witchcraft at Bury-St.-Edmund's in 1662, and was the last English judge who sanctioned the conviction of culprits for that imaginary crime. He was raised to the chief-justiceship of the King's-bench in 1671, where he sat till 1676, on the Christmas day of which year he died. After his death appeared his History of the Pleas of the Crown, the Jurisdiction of the Lords' House, and The History of the Common Law of England; of which there have been repeated editions, with comments. His valuable collection of manuscripts, relating to history and jurisprudence, is preserved in the library of Lincoln's Inn. Sir Matthew Hale also wrote several works on scientific and religious subjects.

HALES, ALEXANDER DE, surnamed the *irrefragable doctor*; an English ecclesiastic, born at Hales in Gloucestershire, celebrated among the controversialists of the thirteenth century. He studied at the universities of Oxford and Paris, in which latter city he lectured, and died in 1245. His Summa Theologiæ was based on the Sententiæ of Peter Lombard; but he gave a syllogistic form to the propositions of that work, and has been on that account called by Tiedemann the first schoolman.

HALESOWEN, a market town of England, in the northern part of Worcestershire, pleasantly situated in a valley on the Stour, 7 miles south-west of Birmingham. It has an ancient parish church, with a beautiful spire, and a monument to Shenstone, who was educated and lies buried here; places of worship for several Dissenting bodies; the remains of an extensive abbey erected by King John; a grammar-school; a new police station and court; &c. Nails, chains, and pearl and horn buttons are manufactured here to a considerable extent; and in the vicinity are coal-mines and corn-mills. Pop. (1901), 4057.

HALÉVY, JACQUES FRANÇOIS FROMENTAL ÉLIE, a French musical composer, was born of Jewish parentage, at Paris, 27th May, 1799. Admitted into the conservatory at the age of ten years, he learned singing under Cazot, the piano under Lambert, and studied counterpoint under Cherubini for five years. In 1819 he carried off the Institute's prize for composition, and was sent to Italy to finish his education.

On his return to Paris in 1822 he attempted to get his first two operas, Les Bohémiennes and Pygmalion put upon the stage, but did not succeed. The first of his pieces performed was a little comic opera, L'artisan, given at the Théâtre Feydau, in 1827. His chef d'œuvre, La Juive, appeared in 1835, and rapidly obtained a European celebrity. Among his other works are L'Eclaire, Guido et Ginevra, La Reine de Chypre, Le Val d'Andorre, La Fée aux Roses. The melodies of Halévy are always soft and flowing, the harmony correct and pleasing; but his works display on the whole more talent than genius. He was a member of the Institut, officer of the Legion of Honour, and secretary to the Academy of Music, and held successively the professorships of singing, harmony, and counterpoint at the Conservatory. He died at Nice, 17th March, 1862.

HALF BLOOD, in law, the relationship of persons born of the same father but not of the same mother, which is called a *consanguinean* relation; or of those born of the same mother but not of the same father, which is termed *uterine*. In the succession to real or landed property in England, 'a kinsman of the half blood inherits next after a kinsman of the whole blood in the same degree, and after the issue of such kinsman when the common ancestor is a male, but next after the common ancestor when such ancestor is a female'. So that brothers consanguinean inherit next after the sisters of the whole blood and their issue; and brothers uterine inherit next after the mother. In Scotland the uterine relations do not succeed to real property in any event, but the consanguinean are in the same position as in English law. As regards personal property in England, the half blood on both sides share equally with the full blood. In Scotland the succession is different, and somewhat complicated.

HALF-PAY, in the army, is granted to officers as a remuneration for past services, especially when they are compelled by ill-health, or some exceptional cause, to quit active service for a time. In the latter case the receipt of half-pay involves an obligation to return to duty when summoned, unless physically disqualified. In no case is an officer kept on half-pay beyond the age at which he might retire on a pension.—In the royal navy half-pay is more of the nature of a retaining fee. During peace, active employment in the higher ranks is exceptional, and in the lower ranks not to be had. When this is the case the officer is placed upon half-pay often for years together. When he is too old for service he retires on half-pay, receiving at same time, in most cases, a step of honorary promotion.

HALF-PIKE, a defensive weapon, composed of an iron spike fixed on an ashen staff. Its use is to repel the assault of boarders in a manner similar to the defence of the charged bayonet among infantry; hence it is frequently termed a *boarding-pike*. It takes the epithet of *half* from its having a much shorter staff than the whole pike.

HALIBURTON, Thomas Chandler, Anglo-American humorous writer, was born at Windsor, Nova Scotia, in 1796. He received his education in his native town, practised as a barrister in Halifax, and in 1842 became judge of the Supreme Court of Nova Scotia. He subsequently gave up his professional duties, and came to reside permanently in England. His first work was a Historical and Statistical Account of Nova Scotia (Halifax, 1829). In 1835 he contributed a series of letters to a Halifax newspaper, under the pseudonym of *Sam Slick*, clock-peddler, a type of the wide-awake, speculation-loving Yankee, who relies upon his knowledge of human nature, and the judicious application of "soft-sawder" for the sale of his clocks. These sketches were published, with considerable alterations and additions, in a collected form in 1837, under the title of The Clockmaker, or Sayings and Doings of Samuel Slick of Slickville, and became very popular. A second series followed in 1838, and a third in 1840. In the Attaché, or Sam Slick in England, his hero is represented as attaché of the American embassy at the court of St. James, and this device gives him an opportunity of making many shrewd observations on society. His hero again appears in Sam Slick's Traits of American Humour (1852). Another work of his of some importance is Rule and Misrule of the English in America (1851). In 1859 Judge Haliburton was elected member of Parliament for Launceston, his politics being of the staunch old Tory kind. He had retired from Parliament before his death, which took place 27th August, 1865, at Isleworth, near London. The author of Sam Slick is an excellent story-teller, and in his power of seizing on the salient points of individual or national character, and of giving a delineation of the same from a satirical or humorous point of view, is almost unapproachable. In the Letter-bag of the Great Western (1839) a number of characters of the greatest diversity are, by means of letters supposed to be written by the passengers to their friends, portrayed with remarkable truth and dramatic distinctness.

HALIBUT. See Holibut.

HALICARNASSUS, the capital of Caria, in Asia Minor, and the residence of the Carian kings. It was once an important commercial city. The present name is *Bodrun* or *Boudroum*. It lies opposite the island of Cos. Queen Artemisia erected here, in honour of her husband, King Mausolus, the celebrated mausoleum, which was regarded as one of the seven wonders of the ancient world. Halicarnassus was the native place of Herodotus, Dionysius the historian, and Dionysius the musician (who wrote on music in the time of Hadrian); also of the poets Hecatæus and Callimachus. For a description of its charming situation, see the Travels of the Younger Anacharsis.

HALICORE. See Dugong.

HALICZ, a town of Austrian Galicia, which has given its name to the province from another form of the word, *Galitsch*. It is situated on the right bank of the Dniester, in the circle Stanislawow, about 14 miles north of the town of that name, and 63 miles S.S.E. Lemberg. It has a Greek church and two synagogues, and on a steep hill in the neighbourhood stand the ruins of an ancient castle, once the residence of the lords of what was formerly the kingdom of Halizia, or Galicia. There are soap and candle factories, and saltworks, which give employment to the bulk of the population, which amounted in 1900 to 4809.

HALIDON HILL, an eminence about 2 miles to the north-west of Berwick, which has acquired some celebrity from having been the scene of a disastrous defeat of the Scots by the English, 19th July, 1333. Edward III. of England, on the pretext that the Peace of Northampton had been broken by the Scots, determined to punish the aggression, and give substantial aid to the new king, Edward Baliol. Advancing from Newcastle with a large army, he laid siege to Berwick, the governor of which promised to surrender on the 20th of July if not previously relieved—the test of an effectual succour being, that 200 of the Scots army should actually join the garrison in the town. The Scots, led by the new regent or guardian, Douglas, lord of Galloway, surnamed the Tyneman, and by the Steward of Scotland, marching to the relief, found the English posted on the north side of Halidon Hill, a strong position, rendered stronger by a marsh around its

lower slopes. Struggling on foot through the morass, and exposed to the deadly archery of the English, they were terribly cut up, and thrown into inextricable confusion. The bowmen could not be dispersed with cavalry; and a compact body of the English having made a sudden attack on the disordered Scots, now but an attenuated fragment of the original force, the result was a total rout. 10,000 Scots were left on the field, among whom were the regent Douglas, and many of the principal nobility. The English loss was trifling. Berwick had immediately to surrender, and Baliol had a short tenure of the throne.

HALIFAX, a municipal, parl., and county borough of England, in the county of York (West Riding). It stands on a declivity rising gently from the Hebble, 36 miles w.s.w. York, on the railway from Bradford to Manchester, and has a very picturesque appearance. It is built almost wholly of stone, which abounds in the vicinity. Some of the streets are narrow and irregular, but others are handsome and spacious. There are many excellent buildings, especially amongst those of modern date. The principal public buildings are the various places of worship, most of them handsome; the town-hall, a fine Renaissance building; post-office, assembly-rooms, two market halls, one a magnificent edifice of freestone; fine new hospital or infirmary (cost £100,000); the new police station; the mechanics' hall, industrial society's stores, baths, &c. The schools, which are numerous, include the grammar-school, the Crossley and Porter orphanage and school, with an endowment of £136,000; the blue-coat school, &c. There are several charitable institutions, including two sets of almshouses, built and endowed by the brothers Sir Francis and Joseph Crossley respectively. The town has a literary and philosophical society, with an extensive museum; a mechanics' institution, with a library; a free library, the town having adopted the Libraries' Act. There is a beautiful little park, the gift of the late Sir Francis Crossley, and other three pieces of ground for public use called respectively Savile, Akroyd, and Shroggs Parks. Halifax is favourably situated for manufactures and commerce, and to this circumstance its prosperity is attributable. It commands abundant supplies of coal and water, and an extensive inland navigation, which connects it with both Hull and Liverpool. The staple articles of manufacture are woollen goods, including carpets (by the great Crossley firm), broad and narrow woollen cloths, and a great many other kinds of woollen fabrics. The manufacture of cotton is also carried on to a considerable extent; dyeing is carried on, and mill machinery, and wool and cotton cards are likewise extensively made. The town is rapidly increasing in extent and population. Halifax sends two members to the House of Commons. Pop. of municipal and parliamentary borough in 1871, 65,510; in 1881, 73,630; in 1901, 104,933.

HALIFAX, a city of Canada, the capital of Nova Scotia, on Chebucto Bay. The harbour of Halifax is one of the best in America; a thousand ships may ride in it in safety. It is easy of access at all seasons of the year. Its length from north to south is about 16 miles, and it terminates in a beautiful sheet of water called Bedford Basin, within which are 10 square miles of good anchorage. The harbour is well fortified, and has an extensive government dockyard, and a large graving-dock. Halifax stands on the western side of the harbour (with the small town of Dartmouth opposite), on the declivity of a commanding hill, 256 high, and, including its suburbs, it is 2½ miles long, and about half a mile wide. The streets are spacious, and cross each other at right angles. Halifax was first settled by a colony under the command of the Honourable Edward Cornwallis in 1749. In 1790 it contained 4000 inhabitants; in 1891, 38,495; in 1901, 40,832. The most important of the government establishments is the dockyard. It has a high wall on the side towards the town, and contains very commodious buildings for the residence of the officers and their servants, besides storehouses and workshops. The province-building is an elegant edifice, and contains the various provincial offices, and apartments for the council, house of assembly, and superior court. There are several other noteworthy public buildings, including a large and splendid Roman Catholic cathedral; Dalhousie University, founded in 1820; an exchange, military hospital, assembly-rooms, theatre, &c. Halifax is the principal naval station of British America, and besides steam communication with Europe and various ports of America, has railway communication which brings it into immediate connection with Western Canada and the United States. Its chief exports are fish and other provisions, lumber, coals, &c.

HALIFAX, Charles Montague, Earl of, an English poet and statesman, was born at Horton in Northamptonshire, 16th April, 1661. He was descended from the Montagues, earls of Manchester, being grandson of Henry, the first earl, and was educated at Westminster School and Trinity College, Cambridge. He first attracted notice by his verses on the death of Charles II.; and in 1687, in conjunction with Matthew Prior, he wrote The Town and Country Mouse, a parody on Dryden's Hind and Panther. He joined in the invitation to the Prince of Orange, was a member of Convention, January, 1689, and became a lord of the treasury in March, 1692. In 1694 he was made chancellor of the exchequer; in 1695 he carried out the much needed re-coinage, appointing Newton warden of the mint; and in 1696 he devised the system of exchequer-bills. His administration was distinguished by the adoption of the funding system, and by the establishment of the Bank of England. As William required money for his wars, and the monied classes knew not where to find safe investments, the national debt was established. In 1698 Montague was a member of the council of regency during the absence of the king; and in 1700 he was raised to the peerage, under the title of Baron Halifax. In the reign of Anne, when Tory influence prevailed, he was twice impeached before the House of Lords; but the proceedings against him fell to the ground, though during the whole reign he remained out of office. However, he actively exerted himself to promote the union with Scotland, and the Hanoverian succession. George I. created him an earl, and bestowed on him the order of the Garter. He was made first lord of the treasury, October 14, 1714, but he did not retain this dignity long, for his death took place on the 19th of the following May. The Life and Miscellaneous Works of Lord Halifax were published in 1715, 8vo; and his poems were included in the edition of English Poets by Dr. Johnson. His patronage of Addison is creditable to his discrimination, though little can be said in praise of his munificence, as with all his arrogance and love of display he was inherently mean. He was a consistent politician, and one of the greatest financiers of his time.

HALIFAX, Marquis of. See Savile.

HALL, an ancient town of Austria, in the Tyrol, the capital of the district of the same name, and situated on the left bank of the Inn, which is here navigable. It is 5 miles east of Innsbruck. It is the seat of a mining and salt directory, and contains a deanery church, built in 1271, with a monument over the grave of Speckbacher, the most daring and skilful leader of the Tyrolese in their struggle for

independence. It has, besides, a gymnasium, a military school, a Franciscan monastery, and a lunatic asylum. It has very extensive salt-works, supplied by the salt mines of the Salzberg, about 9 miles north of the town. Brine from these is conveyed to the pans of the town in wooden pipes. Upwards of 300,000 cwts. of salt are produced here. There are also manufactures of sal-ammoniac and chemicals. Pop. (1890), 5763; (1900), 6191.

HALL, a town of Würtemberg. See SCHWÄBISCH-HALL.

HALL, BASIL, an eminent naval officer and writer, born at Edinburgh in 1788, was the son of Sir James Hall of Dunglass, well known as the author of some excellent papers on geological subjects inserted in the Transactions of the Royal Society. He entered the navy in 1802, became lieutenant in 1808, and after passing some time on the East Indian station with Admiral Sir Samuel Hood, whom he accompanied in a journey over the greater part of the island of Java, returned to England, and shortly after was appointed to the command of a small gun-brig called the *Lyra*. This vessel formed part of the expedition which took out Lord Amherst to China, and by visiting most of the places of interest in the adjacent seas furnished Captain Hall with the materials of his first work, entitled A Voyage of Discovery to the West Coast of Corea, and the great Loo Choo Island in the Japan Sea. This work, first published in 1818 with an appendix of charts and professional or scientific details, afterwards appeared in a more popular form in Constable's Miscellany, and had a very extensive circulation. Captain Hall's next employment was on the South American station, where he commanded the *Conway*. On his return in 1823 he communicated the results of his adventures and observations in a very interesting work, entitled Extracts from a Journal, &c. In 1827 he made a tour in Canada and the United States, and two years after published his Travels in three vols. 8vo. Not long after he published three series of Fragments of Voyages and Travels. In 1834 he travelled on the Continent, and during a visit to the Countess of Purgstall collected the materials of his next work, entitled Schloss Hainfeld, or a Winter in Styria. His last work, entitled Patchwork, was published in 1841. Besides the works already mentioned, he contributed many papers to scientific journals, and to the Transactions of the Royal and other societies, of which he was a member. Ultimately, after a life of unwearied activity, by which both his physical and mental powers had been greatly taxed, his mind unfortunately gave way. He died in 1844 in Haslar Hospital.

HALL, or HALLE, EDWARD, an English chronicler, whose works rank with those of Holinshed and Stow. He was born in London about 1495, and was a lawyer by profession, having attained the rank of a serjeant, and the office of a judge in the sheriff's court. He had a seat in the House of Commons, and was probably a supporter of the reformation movement, though a prudent one. His death took place in 1547. Hall's Chronicle was published in 1550 by Richard Grafton, who is reported to have written the latter part of it. The work is curious, as affording delineations of the manners, dress, and customs of the age. An edition in royal 4to, by Sir Henry Ellis, was published in London in 1809.

HALL, JOSEPH, an eminent English prelate, was born in 1574 at Bristow Park, near Ashby-de-la-Zouch, Leicestershire; entered Emmanuel College, Cambridge, in his fifteenth year, and became a fellow in 1595. Two years after he published his Virgidemiarum, a series of poetical satires, which, notwithstanding a phraseology often obscure and uncouth, are remarkable for elegant and energetic versification, strong and lively colouring, and masterly traces of genuine humour. Meanwhile he was not forgetful of his theological studies, and having taken orders obtained the rectory of Halsted, near St. Edmund's-Bury, where he published a very popular work, entitled A Century of Meditations. In 1605 he accompanied Sir Edmund Bacon to the Continent, and having had considerable opportunity of observing the state of Popery, particularly in the Netherlands, returned more strongly confirmed than ever in the doctrines of the Reformation. Shortly after his return he so pleased Prince Henry by a sermon preached before him that he immediately made him one of his chaplains. In 1617 he obtained the deanery of Worcester, and in 1618 went as one of the English deputies to the celebrated Synod of Dort, where, though he remained only two months, he was so generally esteemed that the members on his departure presented him with a valuable gold medal. This mark of approbation from such a body obviously implied that his religious views were decidedly Calvinistic, but the Arminianism of Laud had not yet gained complete ascendency, and his preferment was finally crowned by his being raised to the see of Exeter in 1627. It would seem, however, that Laud suspected him of holding puritanical principles, and that he found it necessary to defend himself formally from the charge. This he could easily do, as his whole life and writings showed that, however closely he agreed with the Puritans in doctrine, he had no sympathy with their views in regard to church government, and was prepared to make any sacrifice in defence of the episcopacy recognized by the Church of England. Accordingly, after the open rupture between the king and Parliament, he was not deterred by the obvious hazard from coming openly forward and taking a prominent lead in defence of the liturgy and discipline of the church, against the views which the leading Nonconformists had published, in a treatise called, after the initials of the names of its authors, Smectymnuus. In the end of 1641 Bishop Hall was translated from the see of Exeter to that of Norwich, but he had been little more than a year in possession when he was imprisoned in the Tower along with the other prelates who had protested against their expulsion from the House of Peers. When he at last obtained his liberty he was obliged to give bail for £5000. In 1643, when the destruction of the Establishment was finally resolved on, he was specially named in the ordinance passed for sequestering what were called notorious delinquents, and heartlessly robbed of all his property by inquisitors, who turned him houseless into the streets, where he remained till one of his poor neighbours afforded him shelter. Ultimately the sequestration was removed from a small estate which he possessed at Higham, in the vicinity of Norwich. Here he spent the remainder of his days unostentatiously, performing the duties of a faithful pastor, and died at the advanced age of eighty-two in 1656. His prose works were published in 1863 (ten vols.) under the editorship of the Rev. Philip Wynter. They are partly controversial and partly practical. Among the latter, perhaps the best known and most popular is his Contemplations. Dr. Grosart in 1879 issued a complete edition of his poetical works.

HALL, MARSHALL, an eminent physician and physiologist, was born at Basford, near Nottingham, February 18, 1790. He received his early education at Nottingham, and in 1809 he commenced the study of medicine at the University of Edinburgh, and took his degree of M.D. in 1812. While a student at Edinburgh he devoted himself assiduously to professional study, and frequently acted as demonstrator

to Dr. Fyfe, the professor of anatomy. In 1814 he visited France and Germany, and walked from Paris to Göttingen. In 1817 he commenced practice at Nottingham, and soon rose to eminence. In 1826 he settled in London, where, for a quarter of a century, he carried on so successful a practice that at the age of sixty he was enabled to release himself from the more engrossing details of professional labour. In 1853 he visited America, and in 1854 he repaired to Italy for the benefit of his health, but his disease gaining on him he died at Brighton, August 11, 1857. Dr. Marshall Hall paid especial attention to the symptoms of illness. In 1817 he published his Diagnoses of Diseases, which at once earned for him a high reputation, and in 1824 his Medical Essays appeared. His Essay on the Circulation of the Blood, 8vo, 1831, contained an account of his discovery of the so-called 'caudal heart' in the tail of the eel. His writings and practice did much to lessen the indiscriminate use of the lancet by medical men. In the Philosophical Transactions for 1833 was published a paper On the Reflex Functions of the Medulla oblongata and Medulla spinalis, the first of a series of communications in which he embodied the results of his investigations on the nervous system during a period of nearly twenty-five years. The more important of his other writings are: Lectures on the Nervous System and its Diseases (1836), Theory and Practice of Medicine (1837), and Theory of Convulsive Diseases (1848). His services to his favourite science and to the cause of humanity were numerous and valuable, and among these one of the most widely known is the method which he invented of restoring suspended respiration, which is now generally adopted in the case of persons partially drowned. It is known as *The Marshall Hall Method.* (See DROWNING.) A very full memoir was published by his widow in two vols. 8vo (1861).

HALL, ROBERT, a celebrated divine among the Dissenters in England, was born at Arnsby, Leicestershire, May 2, 1764. He was the son of the Rev. Robert Hall, a Baptist minister of Arnsby. His father early remarked his precocity of talent, and observed to a friend that at 'nine years he fully comprehended the reasoning in the profoundly argumentative treatise of Jonathan Edwards on the will and affections.' In 1776 he was placed under the instruction of the eccentric, yet learned and pious, John Ryland, of Northampton. At about fifteen years of age he became a student in the Baptist College at Bristol. On reaching his eighteenth year Mr. Hall entered King's College, Aberdeen, having obtained an exhibition. Here he commenced his acquaintance with Sir James Mackintosh, who was his fellow-student. After receiving his second degree he was chosen as colleague with Dr. Evans in the ministry at Bristol, and adjunct professor in the institution. Here he soon became very popular; but was forced to discontinue his ministrations by mental alienation. After retirement from public life, and a long course of judicious treatment, his lofty mind regained its liberty and power. In 1791 Mr. Hall removed to Cambridge, and became successor to the extraordinary Robert Robinson. He soon became celebrated as a writer, by his publication of a pamphlet entitled Christianity not Inconsistent with the Love of Freedom. This was shortly after followed by his Apology for the Freedom of the Press, which remains to the present day a standard work. Dugald Stewart deemed it the finest specimen of English composition extant at the time when it appeared. But his Sermon upon Modern Infidelity established his fame as a divine. In 1802 Mr. Hall's mind again received a shock, which required his abandonment of pulpit labours. On recovering from his malady he became pastor of the church at Leicester. His ministry in that populous town was equally successful. Here Mr. Hall for twenty years exercised his talents for the good of an affectionate people; but in 1825 the church at Broadmead, Bristol, which had enjoyed his earliest labours, having lost their pastor, the learned and venerable Dr. Ryland, president of the college, invited him to labour amongst them, and in 1826 Mr. Hall removed to Bristol, where his popularity was as great as it had been in other places. He died February 21, 1831. A complete edition of his works, with a memoir of his life, by Olinthus Gregory, and a critical estimate of his character and writings by John Forster, was published at London in six vols. 8vo in 1832, and has been frequently reprinted.

HALLAM, HENRY, a celebrated writer on the history of the British constitution and the literature of Europe, was the son of the dean of Bristol, and born at Windsor in 1777. After an education at Eton he entered Christchurch, Oxford, where he acquired some reputation as a classical scholar. Having fixed his residence in London, and married, he contributed some papers to the Edinburgh Review, and in 1818 made his appearance as an author by his View of the State of Europe during the Middle Ages, a work which at once established his reputation, and is now acknowledged as a standard work. His next work, the Constitutional History of England, published in 1827, placed him at the head of the writers on this important subject, and though somewhat carped at for its liberality by critics of a certain school, is justly regarded as a model at once of laborious research and scrupulous impartiality—an impartiality so scrupulous, that his readers are sometimes perplexed to discover to which side his judgment inclines. His Introduction to the Literature of Europe (1837–39), if it could not add to his reputation, certainly did not detract from it. While composing it, Mr. Hallam's domestic happiness was unimpaired, but previous to its publication it had received a blow of the most distressing kind. His family consisted of his wife, and two sons and two daughters. Arthur Henry, the eldest born, a youth of the highest promise, was suddenly cut off after attaining manhood. The great hopes which were buried with him may be gathered from a most affecting Memoir printed by his father for private circulation, while Tennyson's In Memoriam, of which Arthur Hallam is the subject, has raised to him a durable monument. The breach thus made was repeated by successive strokes, the first of which deprived him of a daughter, the second of his wife, and the third of his son, who died suddenly in 1850, at the age of twenty-six, when his father, now far advanced in life, was hoping that his talents and virtues might supply the place of the elder brother, in whose early death so many hopes had been extinguished. Now left solitary, Mr. Hallam lived in retirement, and resided at Packhurst, in Kent, with his only surviving child, the wife of Colonel Cator, employed chiefly in revising and improving his previous publications. The result appeared in an edition of his collected works, published by Mr. Murray in 1857, in ten volumes. At his death, on the 21st of January, 1859, at the age of eighty-two, his mental faculties were little, if at all impaired.

HALLE, usually called HALLE AN DER SAALE, to distinguish it from other places of the same name, an important German town in the Prussian province of Saxony, circle of Merseburg, situated about 20 miles north-west of Leipzig, on the river Saale, and now an important railway centre. It consists of an old town and extensive suburbs, the former having many of the streets narrow and crooked. Among the public buildings, the church of the Virgin,

in the Gothic style, with four towers and a very fine interior; the mediæval Rathaus (restored); the so-called 'Red Tower' in the market-place, a clock-tower dating from the fifteenth century; the Moritz-kirche, dating from the twelfth century, with fine wood carvings, &c.; the Protestant cathedral; the Moritzburg, formerly a citadel, and residence of the archbishops of Magdeburg, now partly in ruins—all deserve mention, as also the university buildings, now very extensive (especially those accommodating the medical faculty), the post-office, the theatre, &c.; in the suburb of Glaucha the celebrated Francke's Institution, forming a small town of itself. There are also a deaf and dumb asylum, a lunatic asylum, &c. The trade and manufactures of Halle are extensive. The latter include starch, beet-root sugar, chemicals, oil, &c., works for various kinds of machinery, besides the celebrated salt work, one of the oldest in Germany. The salt-workers are known by the name of *Halloren*, and form a class by themselves. The University of Halle is a celebrated institution. It was opened in 1694, and after reaching a high degree of prosperity, was suddenly suppressed by Napoleon after the battle of Jena in 1806. It was re-established by the Westphalian government after the Peace of Tilsit, but in 1813 it was again abolished by Napoleon. After the battle of Leipzig it was once more restored, and the University of Wittenberg was incorporated with it. Its prosperity then rapidly increased, and in 1829 it had about 1300 students. The number afterwards decreased, but it has again risen to about 1500. Halle was for a long time the seat of a theology which adhered strictly to the doctrinal views of the first reformers, but it afterwards became distinguished rather for its rationalistic views. The fame of the university is not merely theological, however, for among its professors have been men eminent in every department of knowledge, and the students have facilities and appliances for scientific education exceptionally excellent and ample. The library numbers 100,000 volumes. Another celebrated institution is Francke's Institution, also called the orphan house (Waisenhaus), founded by August Hermann Francke, pastor of Glaucha, and professor at Halle, who began by giving gratuitous instruction to poor and neglected children, and by taking the charge of a few orphans. This was about 1693. By the help of the benevolent he was soon able to erect a regular orphanage (1698), and schools followed, not merely for the poor, but for children whose parents wished them to be educated under Francke's supervision. In 1714 there were 1075 boys and 700 girls receiving instruction here. Francke died in 1727, but the institution founded by him continued to prosper, and now includes, besides the orphan asylum, a great variety of schools from the elementary school up to the gymnasium and the real school, partly free partly not, attended by between 3000 and 4000 pupils. With the institution is connected a printing and publishing establishment, and a laboratory where medicines are prepared and sold. The revenue of the institution is now partly derived from landed property, partly from the proceeds of the different establishments, partly by grants from government Halle is mentioned under the name of *Halla* as early as 806. It began to have a considerable trade about the beginning of the twelfth century, and in the next two centuries was a powerful member of the Hanseatic League. Its prosperity suffered much from the effects of the Thirty Years' and the Seven Years' wars. Pop. (1895) 116,304; (1900), 156,661.

HALLEIN (Latin, *Halla*), a town of Austria, in Salzburg, on the left bank of the Salzach, near the foot of the Dürnberg, 9 miles south of Salzburg. It is the seat of a salt directory, and several other public offices; contains five churches, a town-house, courthouse, hospital, and boys' and girls' school; and has manufactures of cigars, cement, and articles in wood, and extensive salt-works. Its salt-mines, which have been worked for above six centuries, have a depth of above 350 feet, and yield annually about 15,000 tons. Pop. (1900), 6608.

HALLELUIA, or HALLELUJAH, or ALLELUIA (Hebrew), praise ye the Lord; an expression which occurs often in the Psalms, and which was retained when the Bible was translated into the various languages, probably on account of its full and fine sound, which, together with its simple and solemn meaning, so proper for public religious services, has rendered it a favourite of musical composers. The vowels in it are very favourable for a singer. The Roman Catholic Church does not allow it to be sung on the Sundays during Lent, on account of the mournful solemnity of the season; and in that church it is not sung again before Easter. It is no longer sung in masses for the dead as formerly, and in general it is not used in the penitential seasons, nor in services where humiliation is to be expressed. In the time of Augustine the African Church used this doxology only from Easter to the feast of Pentecost. The Greeks made an earlier or more common use of the Halleluja than the Latin Church. The Jews call the Psalms cxiii.–cxvii. the *Great Halleluja*, because they celebrate the particular mercies of God towards the Jews, and they are sung on the feast of the Passover, and on the feast of Tabernacles.

HALLER, ALBRECHT VON, a celebrated Swiss physician, distinguished not only for his acquaintance with the physical sciences, but also for his general knowledge of literature, and his talents as a poet. His father, Nicholas Emmanuel von Haller, was an advocate and citizen of Bern, where the son was born in October, 1708. He was sent to a public school after his father's death in 1721; and in 1723 he was removed to the house of a physician at Bienne for the study of philosophy. Here he pursued a somewhat desultory course of reading, and exercised himself in poetical composition. However, at the close of the year last mentioned, having chosen the medical profession, he went to the University of Tübingen, where he studied comparative anatomy under the famous Duvernoy; and in 1725 he removed to Leyden, then the first medical school in Europe, Boerhaave and Albinus being among the professors. He received his doctor's degree at Leyden in 1726. After extensive travels in England and France he went to Basel in 1828 to study mathematics under John Bernoulli. Here he first imbibed a taste for botany, and laid the plan of a work, which he long after published, on the plants of Switzerland. Here he composed his poem On the Alps (Die Alpen), followed by various ethical epistles and other pieces, which gave him a reputation in Germany. In 1729 he returned to his native city, and entered on his professional career as a public lecturer on anatomy. For a short time he held the appointments of physician to the hospital, and principal librarian and curator of the cabinet of medals; but in 1736 he received the professorship of anatomy, surgery, and botany, in the newly founded University of Göttingen. Through his influence the university was enriched with a botanical garden, an anatomical theatre, a school for midwifery, and a college of surgery. His own researches in physiology alone were enough to immortalize his name. After the death of his master, Boerhaave, in 1738, Haller published his Prelections, with much original matter, in six volumes, which appeared successively from 1739 to 1745. But his own discoveries and improvements tended to render

this work obsolete; and in 1747 appeared the first edition of his Primæ Lineæ Physiologiæ, a synopsis of his own system of that important branch of medical science, as subsequently developed in a larger work. This is a truly valuable production, which, long after the death of the author, was used as a text-book in schools of medicine. In 1752 he first advanced his opinions on the properties of sensibility and irritability as existing in the nervous and muscular fibres of animal bodies; doctrines which attracted much attention, and excited great controversies in the medical world. After seventeen years' residence at Göttingen, his disagreements with his colleagues induced him to return, in 1753, to Bern, where his countrymen received him with the respect due to his great fame and talents. He settled again among them; and having been elected a member of the sovereign council of the state, he soon obtained by lot one of its magistracies, and entered with zeal on the duties of a citizen, though he did not neglect his scientific pursuits. He was elected in 1754 one of the foreign associates of the Paris Academy of Sciences. In 1758 he accepted the appointment of director of the public salt-works at Bex and Aigle, with a small salary. He resided six years at La Roche; and in the course of his superintendence he introduced many improvements in the manufacture of salt. While thus engaged, he began the publication of his Elementa Physiologiæ Corporis Humani (Lausanne, eight vols. 4to, 1757–66). His next important literary labours were the Bibliothecæ, containing chronological catalogues of works of every age, country, and language, relative to subjects connected with medical science, with concise analyses, and notices of peculiar and important facts and opinions. These libraries of professional knowledge were published in the following order: Bibliotheca botanica (1771, two vols. 4to); Bibliotheca anatomica (1774, two vols. 4to); Bibliotheca chirurgica (1774, two vols. 4to); Bibliotheca Medicinæ practicæ (1776–88, four vols. 4to, the last two volumes having appeared posthumously). On his return from La Roche he was chosen member of the Chamber of Appeal for the German district, of the council of finance, and of other bodies; and also perpetual assessor of the council of health. His various duties as a statesman, a physician, and a medical teacher, occupied his attention till his death, which happened December 12, 1777. He had previously suffered much from illness; but his last moments were peculiarly tranquil. Placing his finger on his wrist, to observe the motion of the artery, he suddenly exclaimed to his physician, 'My friend, I am dying; my pulse stops;' and he immediately expired.

Haller is considered one of the greatest German poets of the eighteenth century. His philosophical and descriptive poems display depth of thought and richness of imagination. He had to contend with a language which was then imperfect, and to the polishing of which his writings contributed. His Elegiac Poems (Die elegischen Gedichte) are still frequently republished in Germany. He wrote in prose three philosophico-political romances—Usong, Alfred the Great, and Fabius and Cato—designed to exhibit the respective advantages of different forms of government, and corresponded in German, Latin, Italian, English, and French with all parts of Europe.

HALLEY, EDMUND, a distinguished mathematician and astronomer, was born at Haggerston, near London, in 1656, and was sent first to St. Paul's School, and then to Queen's College, Oxford, of which he became a commoner in his seventeenth year. Before he was nineteen he published A Direct and Geometrical Method of finding the Aphelia and Eccentricity of Planets, which supplied a defect in the Keplerian theory of planetary motion. By some observations on a spot which appeared on the sun's disk in July and August, 1676, he established the certainty of the motion of the sun round its own axis. August 21, the same year, he fixed the longitude of the Cape of Good Hope by his observation of the occultation of Mars by the moon. Immediately after he went to St. Helena, where he stayed till 1678, making observations on the fixed stars of the southern hemisphere, which he formed into constellations. In 1679 he published Catalogus Stellarum Australium, sive Supplementum Catalogi Tychonici, &c., which procured him the appellation of the *Southern Tycho*. He then went to Dantzig to settle a dispute between the English philosopher Hooke and the famous Hevelius relative to the use of optical instruments in astronomical researches, deciding in favour of the latter. In 1680 he set off on a continental tour, and at Paris made acquaintance with Cassini. After visiting Italy in 1681 he returned to England, and settled at Islington, where he fitted up an observatory for his astronomical researches. In 1683 he published his Theory of the Variation of the Magnetical Compass, in which he endeavours to account for that phenomenon by the supposition of the whole globe of the earth being one great magnet, having four circulating magnetical poles or points of attraction. His theory, though unsatisfactory, is ingenious. The doctrines of Kepler relative to the motions of the planets next engaged his attention; and finding himself disappointed in his endeavours to obtain information on the subject from Hooke and Sir Christopher Wren he went to Cambridge, where Newton, then mathematical professor, satisfied all his inquiries. In 1691 he was a candidate for the Savilian professorship of astronomy at Oxford, which was obtained by Dr. David Gregory. According to Whiston he lost this office in consequence of his character as an infidel in religion. For the purpose of making further observations relative to the variation of the compass he set sail on a voyage in 1699, and having traversed both hemispheres arrived in England in September, 1700. The spot at St. Helena where he erected a tent for making astronomical observations is distinguished by the appellation of *Halley's Mount*. As the result of his researches he published a general chart, showing at one view the variation of the compass in all those seas with which English navigators were acquainted. He was next employed to observe the course of the tides in the English Channel, with the longitudes and latitudes of the principal headlands, in consequence of which he published a large map of the Channel. In 1703 he was engaged by the Emperor of Germany to survey the coast of Dalmatia; and returning to England in November of that year he was elected Savilian professor of geometry on the death of Dr. Wallis; and he was also honoured with the diploma of LL.D. He subsequently published a Latin translation from the Arabic of a treatise of Apollonius Pergæus, a Greek geometer, to which he made additions, to supply the place of what was lost. He next assisted his colleague, Dr. Gregory, in preparing for the press Apollonius on Conic Sections. In 1719 he received the appointment of astronomer-royal at Greenwich, where he afterwards chiefly resided, devoting his time to completing the theory of the motion of the moon, which, notwithstanding his age, he pursued with enthusiastic ardour. In 1721 he began his observations, and for the space of eighteen years he scarcely ever missed taking a meridian view of the moon, when the weather was not unfavourable. In 1729 he was chosen a foreign member of the Academy of Sciences at Paris. He died January 14, 1742, at

Greenwich, and he was interred at the church of Lee, in Kent. In 1752 appeared his Astronomical Tables; and he was the author of a vast multitude of papers in the Philosophical Transactions. For the comet called by his name, see COMET.

HALL-MARKS. See PLATE.

HALLOW-EVEN, or HALLOWE'EN, the evening of the 31st of October, so called as being the eve or vigil of All Hallows, or festival of All Saints, which falls on the 1st of November. It is associated in the popular imagination with the prevalence of supernatural influences, and is clearly a relic of pagan times. All over the United Kingdom nuts and apples are in great request with the young and unmarried, and are used for purposes of divination in love affairs. In the north of England Hallowe'en is known as Nutcrack Night. In Scotland the ceremonies of the eve were formerly regarded in a highly superstitious light, and Burns' Hallowe'en gives a humorous and richly imaginative presentment of the usual ceremonies as practised in Scottish rural districts in his day. The principal object of curiosity in consulting the future was to discover who should be the partner in life. Popular belief ascribed to children born on Hallowe'en the faculty of perceiving and holding converse with supernatural beings.

HALLUCINATIONS, according to Esquirol, are morbid conditions of mind in which the patient is conscious of a perception without any impression having been made on the external organs of sense. Hallucinations are to be distinguished from delusions, for in these there are real sensations, though they are erroneously interpreted. For example, one under a hallucination, though alone in a room, may imagine himself surrounded by enemies, while one under a delusion might transform his relatives and friends into foes. Pinel was the first who connected hallucinations with a disturbance of the phenomena of sensation, and the investigation has been pursued further by Esquirol, Maury, Brière de Boismont, and others. They have studied these phenomena from the different points of view of history, psychology, physiology, and medical jurisprudence, and have thereby done much benefit to society as well as to science. All the senses are not equally subject to hallucinations; the most frequent are those of hearing; next, according to many, come those of sight, smell, touch, and taste; and hallucinations of several senses may exist simultaneously in the same individual. They may also be complicated with certain delusions. Often even the hallucination of one sense is confirmed by the delusion of another, so that it is neither possible nor necessary always to distinguish hallucinations from delusions. The simplest form of hallucinations of hearing is the tingling of the ears; but the striking of clocks, the sounds of musical instruments and of the human voice are often heard, and in these instances, as in those of the perturbations of the other senses, there must be a diseased sensorium, though there should be no structural derangement of the nerves. Hallucinations are not confined to those whose mental faculties have been alienated, but occasionally assail and torment even the sane. In such cases the nervous disturbance is not of sufficient strength to entirely overthrow the mind; and there are instances in which general constitutional states, or positive disease, involve such disturbance of the functions of the external senses as produces these phenomena. Occasionally, where the system is perfectly healthy, and the individual affected is fully conscious of the unreality of the objects that address his senses, hallucinations supervene, but in this case too there is an abnormal or excited condition of the special organ or of the brain itself, falling short of disease, and not obstructing the ordinary functions of the intellectual economy, but often associated with much ability and wisdom in the conduct of life. Abercromby speaks of a man who was all his life assailed by hallucinations. When he met a friend in the street he was not fully aware whether he had to deal with a real personage or with a phantom. With much attention he became able to establish a difference; he found the features of an existing figure more permanent than those of a phantom, but he had to assist himself by touch, or by listening to the sound of the footfalls, to assure himself that he had not encountered a spectre. He had the faculty of giving an objective and sensible existence to all the visions of a disordered sensorium. The second Earl Grey was haunted by a gory head, but he could dismiss it at will. Swedenborg had a similar faculty; and Bernadotte, king of Sweden, was besieged in his rides by a woman in a red cloak, being perfectly conscious of the hallucination under which he laboured. Lord Brougham proposed that the existence of hallucinations should be established as an authoritative test for the existence of insanity; but, as will have been seen, this would be no test at all. The proportion of the hallucinations of the various senses has been by some tabulated thus:—hearing, 49; vision, 48; taste, 8; touch, 3; smell, 1. All are more frequent in mania than in monomania, and in mania errors of vision are more numerous than those of hearing.

HALLUIN, a commune and town of France, department of Nord, on the right bank of the Lys, 10 miles N.N.E. of Lille. It is famous for its cloths, and has extensive manufactures of linen, calicoes, and bed-ticks. It has cotton and oil mills, bleachfields, brickworks, breweries, &c Pop.(1896),11,552.

HALO, the name given to coloured circles sometimes seen round the sun or moon, and to other connected luminous appearances. Sometimes as many as three circles are seen round the sun. The radius of the first subtends an angle of 22°, that of the second 46°, and that of the third, when seen, 90°. A white band across the sun, parallel to the horizon, is also sometimes seen; and sometimes a second white band, perpendicular to the first. These bands form a cross, and stretch out so as to cut the circles of the halo. It is on these bands that parhelia or mock suns are formed. The explanation of haloes is complex and difficult. Mariotte attributed the coloured rings to refraction of light through small crystals of ice in the air, and calculation appears to confirm his hypothesis. The third circle is probably due to refraction of light that has undergone internal reflection in the crystals in a way similar to that which occurs in the formation of the rainbow. On the other hand, the white bands crossing the sun must be due to reflection of light from the surfaces of the crystals. We must, however, refer the reader to treatises on optics for fuller explanation.

HALS, FRANS, a Dutch painter, born at Antwerp about 1580 (some say 1584). When young he went with his parents to Haarlem, where he studied painting under Karel van Mander. His first dated work is a portrait belonging to the year 1613, his next, the Banquet of the Officers of the Haarlem Corps of Harquebusiers of St. George, 1616, one of the earliest pictures belonging to the Dutch school of genre painting, of which Hals is sometimes regarded as the founder. He executed a number of pictures of similar character, as well as many single-figure pieces, and numerous portraits, all of high value artistically. Adrian van Ostade, Wouwerman, and Adrian Brouwer, were among his pupils. He is said to have been improvident in his habits, and latterly received a pension from the municipality of Haarlem. He died in 1666. His brother DIRK, and his son, FRANS HALS, THE YOUNGER, were also excellent painters.

HALSTEAD, a market town, railway-station, and parish, England, county of Essex, pleasantly situated on both sides of the valley of the Colne, 43 miles north-east of London and 18 miles N.N.E. of Chelmsford. There are manufactures of silk and crape, and iron-works for the manufacture of patent slow-combustion stoves. Brewing and malting are also carried on. Pop. (1891), 6056; (1901), 6072.

HALYARDS, HALLIARDS, or HAULYARDS, the ropes or tackles usually employed to hoist or lower yards, gaffs, &c. Thus there are top-sail halyards, top-gallant halyards, royal halyards, &c. The halyards attached to the outer end of a gaff are called *peak* halyards, to the inner end *throat* halyards.

HALYBURTON, THOMAS, a divine of some eminence, born at Dupplin, near Perth, in December, 1674, was son of the minister of Aberdalgy. On the death of his father, who had previously been ejected for nonconformity, young Halyburton was taken by his mother to Holland, where he became a good classical scholar. Having returned to Scotland in 1687 he studied for the church, and in 1700 became minister of Ceres in Fife. Ten years later he obtained the chair of divinity in St. Leonard's College, St. Andrews. The diligence and ability with which he discharged the duties both of parish minister and professor did not appear fully till after his death in 1712, at the early age of thirty-eight, when the works which he had composed were published for the first time. They are all excellent, were once very popular, and bear the respective titles of Natural Religion Insufficient, and Revealed Necessary to Man's Happiness in his Present State; The Great Concern of Salvation; and Ten Sermons preached before and after the Celebration of the Lord's Supper; together with an Essay on his Life and Writings. They were published by Robert Burns, D.D. (London, 1835).

HAM, one of the three sons of Noah, from whom the earth after the Deluge was peopled. He is first mentioned between the other two—Shem, Ham, and Japheth; but afterwards he is expressly designated the younger son of Noah, that is, relatively to the other two. He had four sons—Cush, Mizraim, Phut, and Canaan. The first three travelled southwards, and from them chiefly sprang the tribes that peopled the African continent, as Canaan became the father of the tribes that principally occupied the territory of Phœnicia and Palestine. Ham is also used as a designation of Egypt, most likely on account of its population having sprung from a son of Ham, and the name Ammon, by which the chief god of the northern Africans was often called and worshipped, probably derives its origin from the same source.

HAM, a town of France, in the department of Somme, 15 miles S.S.E. of Peronne, surrounded by a marshy plain. It is an ancient place, coins having been struck here in the reign of Charles the Bald (840–877), and contains a church with fine bass-reliefs and a curious crypt; but is chiefly deserving of notice for its citadel, built in 1470, which has been much strengthened by modern works, and serves as a state-prison, in which were confined Prince Polignac and three other ministers of Charles X., who signed the ordonnances for the *coup-d'état* of 1830; and Louis Napoleon Bonaparte, for a premature attempt to seize the government of France. The latter made his escape, and subsequently became the Emperor Napoleon III. Ham has manufactures of cotton goods, beet-root sugar, and clogs; and ten annual fairs. Pop. 2873.

HAM, the inner angle of the joint which unites the thigh and the leg of an animal, but more generally understood to mean the cured thigh of the ox, sheep, or hog, especially the last. Ham-curing is now an important branch of business, especially in Great Britain and America, and the details of the process are generally the same everywhere. The meat is first well rubbed with salt, and a few days after it is rubbed again with a mixture of salt, saltpetre, and sugar, though sometimes the saltpetre is omitted. After lying in the tub for eight or ten days it is ready for drying. *Wet-salting* requires three weeks, and *dry-salting* four. The smoking of hams is carried on in smoking-houses which are of two or three stories, the meat being hung as high as possible, and subjected to the smoke of a fire kindled on the ground-flat, and which ascends through holes in the flooring. Oak or beech chips generally constitute the fuel, though peat is sometimes used in parts of Great Britain, and juniper twigs in Westphalia. The different species of pine are not taken for fuel, as they impart a disagreeable flavour. The process of smoking is for the most part carried on in winter, the fire being kept in a smouldering state for five or six weeks. Westphalian hams, from the delicacy of their flavour, are a favourite relish. Wood is used in preference to coal in the process of smoking, because of the preserving qualities of pyroligneous acid. In the choice of a ham a sharp knife thrust under the bone should have a pleasant smell when withdrawn. The recently cut fat should be hard and white, the lean fine-grained and of a lively red.

HAM, WEST, a mun., county, and parl. borough in the eastern suburbs of London, in the county of Essex, and on the Thames opposite Greenwich. It comprises the town of Stratford on the river Lea, and is an almost purely working-class district, the inhabitants being chiefly employed in industrial works of various kinds, gas-works, and in connection with the Victoria and Albert Docks. It sends two members to Parliament. Pop. in 1881, 128,953; in 1891, 204,902; in 1901, 267,308.

HAMADAN, a city of Persia, in the province of Irak-Ajemi, 260 miles north-west of Ispahan, agreeably situated near the base of a range of mountains. It is without any architectural objects of interest, the streets are narrow and dirty; but the city has a lively and bustling air about it, and extensive bazaars. There are a vast number of tanneries in the city, the leather manufactured here supplying a large portion of all that is used in Persia. There are also considerable manufactures of coarse carpets, woollens, and cotton stuffs. Wine and rakee—the latter a liquor distilled from the juice of the grape—are made by the Armenians. The trade which passes through the city is large, Hamadan being the great centre where the routes of traffic between Persia, Mesopotamia, and Syria converge. During eight months in the year the climate is delightful, but in winter the cold is excessive, and fuel with difficulty procured. This city is supposed to stand on the site of the ancient Ecbatana, built by Deioces, the first king of the Medes, for his imperial residence, and contains two celebrated tombs—that of Avicenna, the famous Arabian philosopher and physician, attracting yearly numerous pilgrims; and another, which is said to be that of Mordecai and Esther. The principal remains of the ancient city are the fragments of sculptured stone to be seen in the foundations of walls and houses, and ancient coins and medallions. Pop. estimated at 30,000.

HAMADRYADS, in mythology, eight daughters of Hamadryas, by her brother. They received their names from trees, and are the same as the Dryads (which see). They were conceived to inhabit each a particular tree, with which they were born, and with which they perished. They seem to be of Arcadian origin, and never appear together with any of the great gods. Any one sparing a tree at their en-

treaties was rewarded, while the destroyer of groves was sometimes severely punished. See ERYSICHTHON.

HAMAH, or HAMATH, a city of Syria on the caravan road from Aleppo to Damascus, 110 miles N. by E. of Damascus, with which it is now connected by rail. It stands on both banks of the Orontes, here crossed by several bridges. The town is dirty and the streets narrow; the houses, with the exception of a few of the best, are built in the Damascus style of sun-dried bricks and wood, but are said to be richly and elegantly fitted up within. The principal buildings are the palace of the Mutessarif, and thirteen mosques, some of which have very fine minarets. In the middle of the city is a square mound, on which formerly stood the castle, but it has completely disappeared. There are several bazaars, baths, and many fine residences, with spacious gardens attached. The principal trade of the city is with the Bedouins and with Aleppo. Among the greatest curiosities are the Persian water-wheels which supply the upper town with water. They are about a dozen in number, the largest about 70 feet in diameter. By means of these, buckets of water are raised, which empty themselves into stone aqueducts supported by lofty arches on a level with the hill, and by this means the houses and mosques of the town are supplied with water. Hamah is supposed to occupy the site of the Epiphania of the Greeks, a name given to it at the period of the Alexandrian conquest. It is probably the capital of the kingdom of Hamath, the king of which sent presents to David, and entered into an alliance with him after he had conquered the kingdom of Zobah. Pop. about 50,000.

The famous Hamath Inscriptions were noticed by Burckhardt in 1812, and rediscovered in 1870, and in 1873 they were removed to Constantinople. They are on four stones of black basalt, and the inscriptions are in relief, sharply cut. The surface round the characters is sunk, and there are divisional lines in relief between the lines of characters. No key to their decipherment has yet been discovered. What is certainly known is, that in the time of the Assyrian Empire the Hamath characters were in use. The inscriptions are written, the first line from left to right, the second from right to left, the third from left to right, &c. The characters are either hieroglyphic or modified forms of hieroglyphs, but the style and drawing are quite different from the Egyptian, making a marked distinction in character between the two classes of inscriptions. The inscriptions are now regarded as Hittite.

HAMAN. See ESTHER.

HAMANN, JOHANN GEORG, German writer, born at Königsberg in 1730, died at Münster in 1788. He studied a variety of subjects, and tried various occupations—was private tutor, employee in a commercial house, clerk in a public office, &c. He published a number of miscellaneous pieces, more or less humorous, more or less serious, but failed to attract general favour partly on account of the obscurities of his style, though he exercised considerable influence on Goethe, Herder, &c.

HAMBATO, or AMBATO, a town of Ecuador, capital of the province of Tunguragua, 80 miles S.E. of Quito. It was destroyed in 1698 by an eruption of the volcano of Cotopaxi. It was rebuilt shortly afterwards, and soon became more flourishing than before. It has some good buildings, and an active trade in grain, sugar, and cochineal, the latter being produced in the vicinity in abundance and of excellent quality. Pop. 10,000.

HAMBURG, one of the free cities of Germany, with suburban and other possessions, a state by itself, a member of the German Empire, and the greatest commercial port on the continent of Europe, is situated about 80 miles from the mouth of the Elbe, upon the northern side of the river, which here divides into various arms, and is navigable for large vessels as far as this port. It is nearly 180 miles from Berlin. In the northern part are two fine sheets of water, the Binnen Alster and the Aussen Alster, formed by the small river Alster, which flows through the city into the Elbe. Another small river, the Bille, joins the Elbe here, a little to the east of the confluence of the Alster. The northern Elbe enters the city from the east, and gives off a number of canals and branches, some of which ramify through the city, while others form various divisions of the harbour which lies on the southern side of the city. In 1898 the construction of a large new dock basin for the Hamburg-American Steamship Company was entered on, and recently a floating dry-dock has been completed. On the west, and continuous with Hamburg, is the town of Altona. Canals intersect the lower and older part of Hamburg in various directions. In this part the streets are for the most part narrow and crooked. Many of those in the western or New Town are broad and straight. As the result of a destructive fire in 1842, which raged almost unchecked for four successive days, the appearance of the modern city was very much changed and also materially improved, and since then splendid edifices, admirably designed and constructed at enormous cost, have risen up in whole streets of which any city might be proud. Hamburg is not, however, specially rich in public buildings. Among the most important churches are the church of St. Nicholas, a noble Gothic structure with a lofty tower and spire 473 feet high, the whole planned by Sir G. Scott, and built (after the fire) between 1846 and 1863; St. Peter's, another lofty Gothic edifice, also built after 1842; St. Michael's (rebuilt between 1750 and 1762, after being destroyed by lightning), the largest of the churches, with a beautiful portal, a finely-vaulted ceiling, and a spire 469 feet high; St. Catherine's, an ancient edifice, with a spire of 400 feet, and a fine organ; St. James', erected in 1354, but surmounted by a modern tower of 374 feet; and an elegant Jewish synagogue. The Rathaus, or town-house, opened in 1897, is in the style of the German Renaissance. It cost about £500,000. Among other buildings of importance are the exchange, enlarged in 1880–84, and adorned in 1893 with a sandstone façade, a noble edifice, only completed before the conflagration, and though situated in the very heart of it, saved uninjured, consisting chiefly of a magnificent hall, and surrounded by a fine colonnade; the new municipal buildings; the Johanneum buildings or 'Schoolhouse', accommodating a gymnasium (originally instituted in 1529) and a real-school, as well as the city library of about 600,000 vols. and 5000 MSS., and the natural history museum; various technical and other schools; free library; the art building or picture-galleries, founded 1863, extended 1884–86, containing an extensive collection belonging to the city; the central prison; the palace of justice, extended in 1893; the industrial school and museum; the imperial bank; the post-office, erected 1883–86; the conservatory of music; a marine observatory; &c. It has a geographical, a mathematical, and other learned and scientific societies, and there is a chamber of commerce with a valuable commercial library of about 110,000 volumes. A large central railway terminus is to be built. There are several well-endowed hospitals, among others one which receives 500 orphans, and maintains them till educated or apprenticed to a useful trade; a general hospital or infirmary, which can receive from 4000 to 5000 patients; an institute for the study of tropical diseases, &c.; a Jewish infirmary, well endowed, and

a hospital for Jewish widows; a deaf and dumb institution, two asylums for the blind, an observatory, several theatres; fine zoological gardens; botanic gardens, &c. There are statues of Schiller and Lessing, and a monument for the war of 1870-71. Hamburg is of most importance as a commercial town, its shipping trade being exceeded only by that of London, Liverpool, and New York; it also does a great business in banking, exchange, and marine assurance. Its industries, though less important, are still large, and include ship-building, sugar-refining, tobacco and cigar making, iron-founding, distilling, brewing, &c. Immense extensions to its harbour and warehouse accommodation have recently been carried out, and others are still in progress.

As a state Hamburg has a republican constitution. According to the fundamental law the legislative power belongs in common to the senate and the house of burgesses, but the executive power is vested in the senate, which is composed of eighteen members, of whom nine must have studied law or finance, and of the other nine seven must belong to the commercial class. The burgesses choose the members of the senate, who are elected for life, but may retire after six years. The house of burgesses consists of 160 members, chosen from different classes and in different ways, half of whom are elected every three years. The senate, voting by ballot, nominate two of their number as first and second burgomasters for one year, who may be chosen for a second year, but not longer. The legislation is based on the concurrent decisions of the senate and burgesses, who have both the right of introducing measures. In case of a difference of opinion between these two bodies the supreme court of appeal of the three free cities, having now its seat here, is in some cases charged with the settlement of the point at issue; in other cases it is referred to a commission chosen equally from the senate and burgesses. The administration is divided into departments, and the judicial power is exercised by the different tribunals. Religious belief does not restrict the rights of any citizen.

The city of Altona, already referred to, is in the territory of Holstein, and is a separate municipality. Some of the islands in the Elbe belong, either wholly or in part, to Hamburg, together with some of the neighbouring villages. Besides this it has jurisdiction over the bailiwick of Ritzebüttel, which contains the important town of Cuxhaven, at the mouth of the Elbe. To Hamburg also belongs the bailiwick of Bergedorf, with the small town of the same name. The population belonging to the city of Hamburg was, in 1900, 705,738; of the whole territory (about 160 square miles), 768,349.

The city owes its foundation to the emperor Charlemagne, who (808-811) built a citadel and a church on the heights between the Elbe and the eastern bank of the Alster, as a bulwark against the neighbouring pagans. The adaptation of the place for commerce and fishing attracted many settlers. It became important as a commercial city in the twelfth century, and in the thirteenth it combined with Lübeck in forming the Hanseatic League. Even after the decline of the confederacy it maintained its freedom and flourishing commerce. The Hanseatic League with Lübeck and Bremen subsisted till 1810, and has been renewed since 1813 and 1814. Until 1500 the city was confined to the strip of land between the Elbe and the eastern bank of the Alster. The western bank was gradually built upon, principally by exiles from the Netherlands. Thus arose the new town, which was so important, even in the early part of the Thirty Years' war, that it was inclosed within the fortifications. In 1618 Hamburg was formally acknowledged a free city of the empire. The Thirty Years' war, amidst the devastations of which Hamburg was spared, increased the number of its inhabitants, as later wars in Europe have also done, during which many persons emigrated there from the Rhine, from the Netherlands, and from France. The commerce of Hamburg was increased, particularly by its direct intercourse with the United States of America, and by the war in the Netherlands and on the Rhine, by which it obtained a considerable share of the commerce of those countries. Thus, at the beginning of the present century, Hamburg was one of the richest and most prosperous of the free cities. Its reverses began in 1803, with the entrance of the French into Hanover. Together with the whole north-western part of Germany it was formally incorporated in the French Empire (13th Dec. 1810), and became the capital of the newly created department of the Mouths of the Elbe. In the latter part of May, 1814, the French troops first left the city, carrying with them large exactions. In 1815 Hamburg joined the Germanic Confederation as a free city, and as such it joined the North German Confederation in 1867, the German Empire in 1871, and the Zollverein in 1888 (except a small portion comprising the actual harbour and warehouses connected). Its trade is greatly facilitated by the extensive means of communication both with foreign countries and with the interior. By the Elbe large sea-going vessels can ascend at high water, and either deliver their cargoes directly in the warehouses which line the bank, or send them by lighters into the very heart of the town. By the same means, also, free communication is given to the interior, and greatly extended by means of canals which branch off to the Baltic, or penetrate into the basin of the Oder, and through it into that of the Vistula. Railways also now connect Hamburg with all parts of Germany and the Continent. The total number of sea-going vessels belonging to the port in 1900 was 725, of 856.716 tons. The value of the imports by sea in 1899 was £97,276,997; and the exports for that year were valued at £78,741,136. The imports and exports from and to Britain each amounted to about £20,000,000. In 1899 the tonnage of shipping entered by sea was 7,766,000, and that cleared 7,780,000. Hamburg is now a great port of emigration.

HAMELN, a town, and formerly a fortress, of Hanover, beautifully situated on a commanding position on the Weser, here crossed by a long suspension bridge (839 feet), 25 miles south-west of Hanover. It contains many antique wooden and stone houses in the old German style, and has a fine old church, manufactures of woollen and mixed goods, leather, paper, artificial manures, salmon fishing, and a considerable trade. The town is the scene of the legend of the 'pied piper' (or ratcatcher) so well known from Browning's ballad. Pop. (1895), 16,508; (1900), 18,965.

HAMILCAR, a name of common occurrence at Carthage, and borne by several of its most distinguished citizens, among whom we shall only mention HAMILCAR, surnamed BARCA (that is 'lightning'), the father of the celebrated Hannibal. While quite a young man he was appointed to the command of the Carthaginian forces in Sicily, in the eighteenth year of the first Punic war, B.C. 247, when the Romans were masters of almost the whole island. He established himself with his whole army on Mount Hercte (now *Monte Pellegrino*), where he not only succeeded in maintaining his ground, but sent out squadrons to plunder the coasts of Sicily and Italy. In 244 he abruptly quitted his strong position, and, landing at the foot of Mount Eryx, converted the town of that name into a fortified camp for his army. For two years he defied all the efforts of the Romans to dislodge

him; but the Carthaginian admiral, Hanno, having been totally defeated off the Ægates, B.C. 241, he reluctantly consented to evacuate Sicily. His inability to perform the promises which, to keep them in obedience, he had made to his mercenary troops, brought about their revolt after returning from Sicily, and as they were joined by almost all the native Africans, Carthage was brought to the brink of ruin. The incapacity of Hanno, who had been intrusted with the suppression of the revolt, led all parties to concur in the appointment of Hamilcar. He defeated the enemy with great slaughter, reduced their towns to subjection, and after several alternations of fortune, and the appointment of Hanno to a share in the command, the war was brought to a successful close, B.C. 238, after it had lasted three years and four months. He now projected the formation of a new empire in Spain, to be not only a source of strength to Carthage, but the point whence hostilities might be renewed against Rome. This policy was ably prosecuted after his death by Hasdrubal and Hannibal. Hamilcar penetrated into the heart of the country, reduced some cities and tribes, and acquired vast wealth. He passed nine years in Spain, and fell in a battle against the Vettones, a people who dwelt between the Tagus and the Guadiana, B.C. 229, about ten years before his son Hannibal was able to enter on the realization of the great and statesmanlike plans which Hamilcar had laboured so persistently to accomplish.

HAMILTON, a burgh of regality, parliamentary and police burgh of Scotland, in the Middle Ward of Lanarkshire, 10 miles south-east of Glasgow. The older part of the town is situated on the lower grounds near the Clyde, but the newer part is built on sloping grounds to the south and west. Hamilton is a straggling, irregular town, the oldest parts of which date from the early part of the fifteenth century, though much altered since. Some of the streets are not unattractive in appearance. The main street is about 700 yards long, and crosses the course of Cadzow Burn by a bridge 60 feet high. The county courts, the county council, and the town council buildings, and infantry barracks, are the most important public buildings. There are several handsome churches. Coal is the chief industrial product, but other industries are developing. Hamilton Palace, chief seat of the Dukes of Hamilton, to the north-east of the town, is a large building with an elegant north-west front, adorned with a fine portico of Corinthian columns, and situated in very extensive pleasure-grounds on the river Clyde. In the vicinity are the ruins of Cadzow or Cadyow Castle, and in Cadzow Forest, in which a herd of the original breed of wild cattle is kept, there are a few remarkable old oaks. The origin of the town is uncertain, but it was erected into a burgh of barony in 1456. In 1548 it was erected by Queen Mary into a royal burgh; but the rights and privileges thus acquired from the crown were resigned into the hands of the Dukes of Hamilton. In 1668 it was erected into a burgh of regality, and became a parliamentary burgh in 1832. The burgh was greatly extended in 1878. It joins with Falkirk, Linlithgow, Lanark, and Airdrie (the Falkirk burghs) in sending a member to Parliament. The railway communication is excellent, and there is electric tramway communication with Motherwell, Wishaw, and Blantyre. Pop. in 1881, 18,517; in 1891, 24,863; in 1901, 32,775.

HAMILTON, a thriving town of Canada, in the province of Ontario, in the county of Wentworth, on the south side of Burlington Bay, Lake Ontario, the principal part being built about 1 mile from the bay. It is about 40 miles south-west of Toronto, and is situated in the centre of one of the finest grain-producing territories in America, being also an important centre of the chief Canadian railways. The public buildings, many of which are handsome, include jail and court-house, market-houses, custom-house, theatre, churches, library, banks, &c. There are manufactures of iron, cotton, agricultural implements, zinc, tobacco, &c. It is the seat of an active and increasing trade. Pop. in 1891, 48,980; in 1901, 52,550.

HAMILTON, a town of the United States, in Ohio, capital of Butler county, on the Great Miami river, 90 miles W.S.W. of Columbus. It is a prosperous manufacturing place, and contains woollen and cotton factories, paper and saw mills, and iron-foundries. Pop. (1890), 17,565; (1900), 23,914.

HAMILTON, FAMILY OF, is of English origin, the name being evidently territorial. From the index to Domesday Book we learn that there were several manors of this name in the time of William the Conqueror. The first person of the name in Scotland of whom we have reliable information, was: (1) WALTER FITZ-GILBERT of Hamilton, who in 1296 swore fealty to Edward I. of England for lands in Lanarkshire, and held Bothwell Castle for the English at the time of the battle of Bannockburn. For his early surrender of this fortress King Robert Bruce gave him important grants of land. He continued faithful to King David Bruce, and had a command at Halidon Hill under the Steward of Scotland. By his second wife, Mary, only daughter of Adam de Gordon of Huntly, he had two sons, of whom the elder, (2) SIR DAVID of Hamilton, was taken prisoner with the king at the disastrous battle of Neville's Cross, 17th October, 1346. His eldest son, (3) SIR DAVID of Hamilton of Cadyow, who died before 1392, was knighted by Robert II. in 1377. (4) Sir David's eldest son was SIR JOHN of Hamilton of Cadyow, the father of (5) SIR JAMES of Hamilton of Cadyow, who was one of the hostages for James I. when he was allowed to return to Scotland in 1421. By his wife Janet, daughter of Alexander of Livingston of Callander, he had (6) SIR JAMES of Hamilton of Cadyow, and four other sons.

The charter by which nobility was conferred on the family, in the person of the last-mentioned Sir James, is dated July 3, 1445. He was created a lord of Parliament under the title of Lord Hamilton of Cadyow. At first he adhered to the Douglases against the crown; but, deserting them opportunely, he was rewarded by large grants of their forfeited lands, and at a later period by the hand of the Princess Mary, eldest daughter of King James II., and widow of Thomas Boyd, earl of Arran. He died in 1479. His only son was JAMES, second Lord Hamilton and first Earl of Arran, who died in 1529, and was succeeded by his son JAMES, third Lord Hamilton and second Earl of Arran, whose mother was a niece of Cardinal Beaton. His nearness to the throne, and his great possessions and following, made him a person of such mark and consequence that Henry II. of France gave him a grant of the duchy of Châtelherault; and his eldest son, styled the Earl of Arran, aspired to be the husband of Elizabeth of England, and on his rejection by that princess he lifted his eyes to Mary of Scotland, his bootless passion for whom gradually undermined his reason. Consequently on the death of his father, 1575, the second son, LORD JOHN HAMILTON, commendator of Arbroath, created Marquis of Hamilton in 1599, succeeded to the family estates, and became the representative of the family. Dying in 1604 he was succeeded by his son JAMES, the second marquis, who was born in 1589, created Earl of Cambridge in 1619, and died in 1625, a few days before King James. His son James, the third

marquis, one of the ablest and most distinguished of the family, was in 1643 created by Charles I. Duke of Hamilton, and being taken prisoner by the Parliamentary forces soon after the battle of Preston, he was beheaded at Westminster, in March, 1649. He was succeeded by his brother WILLIAM, who had been created Earl of Lanark in 1639, and died in 1651, of wounds received at the battle of Worcester. LADY ANNE, daughter of James the first duke, now succeeded to the duchy in terms of the patent of creation, her husband, Lord William Douglas, earl of Selkirk, being created Duke of Hamilton for life. He died in 1694. In 1698 the Duchess Anne resigned her titles in favour of her eldest son, the Earl of Arran, who was accordingly created Duke of Hamilton with the original precedency. He was created Duke of Brandon in 1711, and was killed in a duel with Lord Mohun in 1712. JAMES, the fifth duke, died in 1743. He was succeeded by his eldest son, JAMES, who died in 1758, and was succeeded by JAMES GEORGE, when only three years old. On the death of Archibald, duke of Douglas, in 1761, he became the male representative and chief of the Angus branch of the house of Douglas, with the titles of Marquis of Douglas and Earl of Angus. He died in 1769, and was succeeded by his brother DOUGLAS, eighth Duke of Hamilton, who, dying without issue in 1799, was succeeded by his uncle LORD ARCHIBALD HAMILTON. He died in 1819, and was succeeded by his eldest son ALEXANDER, who, dying in 1852, was succeeded by his only son WILLIAM ALEXANDER ANTHONY ARCHIBALD. In 1843 he had married the Princess Marie of Baden, and he died at Paris, July 15, 1863. His son WILLIAM ALEXANDER LOUIS STEPHEN DOUGLAS HAMILTON, twelfth Duke of Hamilton in the peerage of Scotland, and ninth Duke of Brandon in the peerage of Great Britain (also Duke of Châtelherault in France), premier peer of Scotland, and hereditary keeper of Holyrood House, died in 1895 and was succeeded by a distant relative.

The ennobled offshoots of the main branch of the Hamiltons are numerous. Among these are the Dukes of Abercorn, the Earls of Orkney and of Haddington, the Viscounts Boyne, and the Barons Belhaven and Stenton. The Earls of Clanbrassil were descended from the Hamiltons of Raploch. The titles of Earl of Selkirk, Earl of Ruglen, and Baron Bargeny, formerly held by scions of this family, are now extinct or merged in others.

HAMILTON, ALEXANDER, a distinguished American officer and legislator during the contest for independence, was born in 1757 in the island of Nevis. His father was a native of Scotland, and his mother of the island, and of French Huguenot extraction. At the age of sixteen he became a student of Columbia College, his mother having emigrated to New York. He had not been in that institution more than a year before he gave a brilliant manifestation of the powers of his mind in the discussion concerning the rights of the colonies. In support of these he published several essays, which were marked by such vigour and maturity of style, strength of argument, and wisdom and compass of views, that Mr. Jay, at that time in the meridian of life, was supposed at first to be the author. When it had become necessary to unsheath the sword the ardent spirit of young Hamilton would no longer allow him to remain in academic retirement; and before the age of nineteen he entered the American army with the rank of captain of artillery. In this capacity he soon attracted the attention of the commander-in-chief, who appointed him his aide-de-camp, with the rank of lieutenant-colonel. This occurred in 1777, when he was not more than twenty years of age. From this time he continued the inseparable companion of Washington during the war, who used to speak of him as his 'principal and most confidential aid,' and was always consulted by him, and frequently by other eminent public functionaries, on the most important occasions. He acted as his first aide-de-camp at the battles of Brandywine, Germantown, and Monmouth, and at the siege of Yorktown he led, at his own request, the detachment that carried by assault one of the enemy's outworks, October 14, 1781. In this affair he displayed the most brilliant valour. After the war Colonel Hamilton, then about twenty-four, commenced the study of the law, as he had at that time a wife and family depending upon him for support. He was soon admitted to the bar. In 1782 he was chosen a delegate from the state of New York to the convention which assembled at Philadelphia to frame the constitution of the United States, where he quickly acquired the greatest influence and distinction, and was always a member and sometimes chairman of those committees to which were confided such subjects as were deemed of vital interest to the nation. The reports which he prepared are remarkable for the correctness and power which characterize every effort of his pen. At the end of the session he returned to the practice of his profession in the city of New York, and became eminent at the bar. In 1786 he was chosen a member of the legislature of his state, and was mainly instrumental in preventing a serious collision between Vermont and New York, in consequence of a dispute concerning territorial jurisdiction. In 1788 he was a member of the state convention of New York, which met to deliberate on the adoption of the federal constitution, and it was chiefly in consequence of his efforts that it was accepted. On the organization of the federal government in 1789, he was appointed to the office of secretary of the treasury. This office he held till 1795, when he resigned, and retired into private life. In 1798 he was appointed second in command of the provisional army raised under the apprehension of a French invasion, and on the death of Washington, in 1799, he became commander-in-chief. On the army being disbanded he returned to the bar, and continued to practise till 1804, when he was shot by Colonel Burr in a duel on July 11. This lamentable event produced the most profound sorrow throughout the United States, and did much to bring the practice of duelling into merited disrepute.

HAMILTON, ANTHONY, COUNT, a poet, courtier, and man of letters in the seventeenth century. He was descended from a younger branch of the family of the dukes of Hamilton in Scotland, but was born in Ireland about 1646. His parents were Catholics and royalists, in consequence of which they removed to France, after the death of Charles I., and young Hamilton became domiciliated in that country. He, however, made frequent visits to England in the reign of Charles II. His sister was married to Count Grammont. It is said that the count, after having paid his addresses to the lady, and been accepted, changed his mind, and set off for the Continent. Her brother followed him, and overtaking him at Dover, asked him if he had not forgotten something to be done previously to his leaving England. 'O, yes,' replied Grammont, 'I forgot to marry your sister;' and he immediately returned and fulfilled his engagement. When James II. was obliged to contend for his crown in Ireland, he gave Count Hamilton a regiment of infantry, and made him governor of Limerick; but on the ruin of the royal cause he accompanied James to France, where he passed the rest of his life. His wit and talents secured him admission into the first circles, where he was generally esteemed for his agreeable manners and amiable dis-

position. He died at St. Germain in 1720. Count Hamilton is chiefly known as an author by his Memoirs of Count Grammont, a lively and spirited production, exhibiting a free, and, in the general outline, a faithful delineation of the voluptuous court of Charles II. It is an admirable chronicle of the frivolous life of the French and English courts of that time. The count's other works are Poems and Fairy Tales, which, as well as the Memoirs, are in French, and display elegance of style and fertility of invention, and are really master-pieces of grace and sprightliness. Horace Walpole printed at Strawberry Hill, in 1772, a 4to edition of the Memoirs of Grammont, with notes and illustrations.

HAMILTON, Elizabeth, a lady of considerable literary attainments, was born at Belfast in Ireland 21st July, 1758. Having become an orphan at an early age, she was brought up under the care of her uncle, who resided near Stirling, in Scotland, and during her residence in his family made herself intimately acquainted with those national peculiarities which she afterwards delineated so admirably in her Cottagers of Glenburnie. Besides this little work, which attracted much attention, she wrote the Letters of a Hindu Rajah (two vols. 8vo); the Life of Agrippina (three vols. 8vo); and Memoirs of Modern Philosophers; works which, under the popular form of novels, are replete with sound sense and information. Her other writings are, Hints for Public Schools; Popular Essays (two vols. 8vo); Rules of the Annuity Fund, &c.; Exercises in Religious Knowledge (12mo); Letters on the Formation of the Religious and Moral Principle (two vols.); and On the Elementary Principles of Education. She held a distinguished rank among contemporary authoresses — Miss Burney, Mrs. Robinson, Charlotte Smith, Maria Edgeworth, Jane Austen, &c. She was never married, but enjoyed an extensive acquaintance, especially among the talented of her own sex, one of whom, Miss Benger, after her decease, printed a selection from her correspondence, with a prefatory account of her life and habits. She died July 23, 1816.

HAMILTON, Gavin, a Scottish painter of considerable distinction in the 18th century, born in the town of Lanark about 1730. Being sent when very young to Rome, he became a scholar of the celebrated Augustine Mossuchi, and there devoted himself during the remainder of his life, with the exception of occasional visits to Scotland, to historic painting. In some of his visits to his native country he painted a few portraits, the best of which are considered to be two full lengths of the Duke and Duchess of Hamilton. He died in 1797. One of his greatest works was his Homer, consisting of a series of pictures representing scenes taken from the Iliad. He published at Rome in 1773 a folio volume entitled Schola Picturæ Italiæ, or the Italian School of Painting, composed of a number of fine engravings by Cunego, making part of the collection of Piranesi; he there traces the different styles from Leonardo da Vinci to the Carraccis; all the drawings were made by Hamilton himself, and this admirable collection now forms one of the principal treasures in the first libraries in Europe. All his best pictures were engraved under his own eye by artists of the first ability. He devoted almost the whole of the latter part of his life to the search, by means of excavation, for ancient objects of art, and in this pursuit he was very successful.

HAMILTON, Patrick, usually considered as the first Scottish reformer, was the second son of Sir Patrick Hamilton of Kincavel and Stanehouse, and of Catharine, daughter of the Duke of Albany, second son of James II. He was probably born in Glasgow in 1504, and was educated partly at St. Andrews and partly at Paris, where he took his degree in 1520. While still a boy he had been appointed Abbot of Ferne, in Rosshire, that he might be enabled to prosecute his studies, with a view to high preferment, with greater ease and success. Having imbibed, during a short residence on the Continent, the principles of the Reformation, when he settled at St. Andrews in 1523 he naturally cherished his new tastes and convictions, though he does not appear to have been loud in promulgating them. But his views becoming gradually more decided, in 1526 he announced them with a decision and publicity that attracted the notice of Archbishop Beaton, who proceeded to take the usual steps to have him formally summoned, and put on his trial. Though Hamilton had meanwhile fled to Germany, there was a professed trial and conviction, by which he was declared to have merited death. An intimacy now formed with Luther and Melanchthon enlarged and deepened his convictions, and after an absence of six months he returned to Scotland. He openly preached the gospel in the neighbourhood of Linlithgow, his scholarly reputation, his pure life, and his admirable courtesy, greatly enhancing the usefulness and authority of his prelections. The clergy were alarmed, and Beaton, under pretence of desiring a friendly conference, contrived to allure him to St. Andrews in January, 1528. The early stages of the conference were marked by a conciliatory spirit, and he held apparently friendly conversations with Alexander Alane, or Alesius, one of the canons in the priory, and with Alexander Campbell, one of the Dominican friars, suborned, it is supposed, by Beaton, to entrap him into damaging avowals of opinion, and who was afterwards his principal accuser. The result of the trial, which took place on the last day of February, was that Hamilton was convicted of divers heresies, deprived of all his ecclesiastical dignities, and delivered over for punishment to the secular power, by which he was condemned the same day. In the afternoon he was hurried to the stake in the area in front of the gate of St. Salvador's College, his martyrdom, which was consummated Feb. 29, 1528, in the twenty-third year of his age, having done more to extend the principles of the Reformation in Scotland than his life could have done. He was a brave, sincere, earnest man. He was the author of Patrick's Places, translated and published by John Frith, reprinted in vol. i. of the Fathers of the English Church, and also to be found in Fox's Acts and Monuments. A Memoir of him has been published by the Rev. P. Lorimer (Edinburgh, 1857, 8vo).

HAMILTON, Robert, LL.D., a mathematician and political economist, was the son of a bookseller in Edinburgh, and born in June, 1743. While studying at the University of Edinburgh he displayed great talents in mathematics, and in 1766, though then but a young man, he was a candidate for the mathematical chair of Marischal College, Aberdeen. After this he became a partner in conducting a paper-mill which had been established by his father—a concern which, in 1769, he relinquished to the care of a manager, on his appointment to the rectorship of the academy at Perth. In 1779 he was presented to the chair of natural philosophy in Marischal College, in the gift of the crown. From this chair he effected an exchange with Dr. Copland to the mathematical chair, as being better suited to his inclination and ability. A short time before this he had commenced the series of useful works which have so deservedly raised his name. In 1777 appeared the practical work so well known by the name of Hamilton's Merchandise. In 1796 he published his Arithmetic, a work which has been frequently reprinted; in 1800 another work of a similar elemen-

tary description called Heads of a Course of Mathematics, intended for the use of his own students: but the great work so generally attached to his name did not appear till he had passed his seventieth year. This was the Inquiry concerning the Rise and Progress, the Redemption and Present State of the National Debt of Great Britain, published at Edinburgh in 1813, and directed against the views which then extensively prevailed regarding sinking funds. At that time it was commonly believed that a nation might borrow money, and assign a part of it to accumulate at compound interest for the repayment of the whole, on which simple interest was paid. Hamilton, however, shows that this is equivalent to deducting that part from the loan—and hence the general scope of his argument goes to prove the utter uselessness of a borrowed sinking fund, and the fallacy of continuing its operation during war, or when the expenditure of the nation overbalances the income. The summary of his proofs and discussions on the subject, as expressed in his own words, was as follows: 'The excess of revenue above expenditure is the only real sinking fund by which the public debt can be discharged. The increase of the revenue, or the diminution of expense, are the only means by which a sinking fund can be enlarged, and its operations rendered more effectual; and all schemes for discharging the national debt by sinking funds, operating by compound interest or in any other manner, unless so far as they are founded upon this principle, are illusory.' Dr. Hamilton died on the 14th July, 1829.

HAMILTON, William, usually called Hamilton of Bangour, from the place of his birth, Bangour, Linlithgowshire, was born in 1704. At the commencement of the insurrection of 1745 he joined the standard of Prince Charles, and was present at the battle of Culloden, after which he became an exile from his native country, but was at length pardoned through the intercession of his friends at home. He died at Lyons March 25, 1754. His poems, which were first published anonymously at Glasgow in 1748, and afterwards reprinted several times, display liveliness of imagination and delicacy of sentiment. He is the author of the well-known ballad of the 'Braes of Yarrow,' and must not be confounded with Hamilton of Gilbertfield in Lanarkshire, the friend and correspondent of Allan Ramsay.

HAMILTON, Sir William, K.B., grandson of William, third duke of Hamilton, was born in Scotland in 1730. In 1761 he was elected member of Parliament for Midhurst, and in 1764 he received the appointment of ambassador to the court of Naples, where he resided thirty-six years. A considerable part of this term being a season of political repose, he devoted his leisure to science, making observations on Vesuvius, Ætna, and other volcanic mountains of the Mediterranean; and the result of his researches is detailed in the Philosophical Transactions, and in his Campi Phlegræi, or Observations on the Volcanoes of the Two Sicilies (Naples, 1776–79, three vols. folio). He took an active part in the excavation of Herculaneum and Pompeii, and collected a cabinet of antiquities, of which an account was published by D'Hancarville, in four vols. royal folio—a splendid work with finely coloured plates. While on his way home to England in 1800 the vessel in which he sailed was wrecked, and many of his antiques were lost. Sir William's second wife was the notorious Lady Hamilton, whose connection with Lord Nelson forms one of the least pleasant portions of that hero's biography. She was married to Sir William in 1791, after having lived under his 'protection' for several years, as previously under that of his nephew. Before this she had been the mother of one or two children. Sir William died in 1803, and his wife in 1815.

HAMILTON, Sir William, one of the ablest of modern metaphysicians, and the most accomplished philosopher of the Scottish school, was born on the 8th of March, 1788, at Glasgow, where his father and grandfather held in succession the chairs of anatomy and botany. Having studied with distinction at Glasgow, in 1807 he entered Balliol College, Oxford, as a Snell exhibitioner, where he gained first-class honours. In 1813 he was admitted to the Scottish bar, and was sometime after appointed crown solicitor of the court of teinds. His formal attendance in this capacity constituted the sole amount of his legal practice. His taste lay in a different direction, and while he diligently applied himself to almost every branch of literature, mental philosophy became his favourite study. In 1820 he became a candidate for the chair of moral philosophy in Edinburgh, rendered vacant by the death of Thomas Brown, but being defeated by Professor John Wilson, he was obliged to content himself with the less popular and far less lucrative chair of universal history, to which he was appointed in 1821, by its patrons, the Faculty of Advocates. In 1826 he became a contributor to the Edinburgh Review, and enriched it with a series of articles so valuable and original that they attracted much attention, not only in this country but on the Continent, and were afterwards published in a collected form, with large additions, under the title of Discussions on Philosophy and Literature, Education, and University Reform. Of these the most celebrated was his Critique of Cousin's Cours de philosophie, in which was developed that philosopher's doctrine of the Unconditioned. Many of these contributions were translated into the leading European languages, and attracted much attention from continental speculators in philosophy. In 1836 he again became a candidate for an Edinburgh professorship, and happily succeeded in gaining the chair which of all men living he was perhaps the best fitted to adorn—that of logic and metaphysics. This chair, which had too often been bestowed by the town-council merely as a piece of patronage in their gift, now assumed its proper place in the curriculum, and Sir William's zeal and ability in discharging the duties of it were rewarded by the number of ardent students whom he gathered around him. The fame of the Scottish school of metaphysicians, which had begun to wane, was gradually re-established; and Sir William's influence would have been felt to even a higher degree had he not been struck with paralysis, from which he never recovered so far as to undertake the full duties of his chair. His mind, however, retained its vigour, and he endeavoured to carry out some of the literary designs which he had previously formed. In 1846 he published an annotated edition of the works of Thomas Reid, and in 1854 the commencement of a similar edition of the works of Dugald Stewart. This undertaking was suddenly terminated by his death at Edinburgh on the 6th of May, 1856. His lectures were published in 1859–61, under the editorship of Mansel and Veitch. His views are chiefly expounded in the Discussions and in the Dissertations appended to his edition of Reid, and are attacked in Mill's Examination. See the Memoir by Veitch (1869), and his little work in Blackwood's Philosophical Classics (1882).

HAMILTON, Sir William Rowan, one of the greatest mathematicians of the 19th century, was born in Dublin in August, 1805. From his earliest years he gave evidence of the most astonishing talents, which were supplemented by an eager thirst for knowledge. He knew Greek and Latin when only six years of age, and before he had completed his fourteenth year he had made himself acquainted with thirteen languages, among which were Arabic,

Persian, Hindustani, Sanskrit, and Syriac. When the Persian ambassador visited Dublin in 1819 he received from Hamilton a letter of congratulation written in Persian, of such purity and accuracy that the ambassador could not help expressing his surprise. When ten years old Hamilton began the study of mathematics, and by the time he was fifteen his knowledge of the subject was as extensive as that of many who have passed through the university curriculum with distinction. In 1822, at the age of seventeen, he presented a paper to Dr. Brinkley, the Irish astronomer-royal, which exhibited such a profound knowledge of mathematics, that the Dr. declared the author of it to be already the first mathematician of his age. Next year he entered Trinity College, and his career there proved as brilliant as had been anticipated—the highest honours that the university had to bestow having been gained by him. Dr. Brinkley having been nominated to the bishopric of Cloyne in 1827, and the chair of astronomy in Trinity College, as well as the post of astronomer-royal, then becoming vacant, Hamilton obtained both appointments, though then only in his twenty-third year. His life henceforth was uneventful and exclusively devoted to abstruse studies. He was knighted in 1835 on the occasion of the first meeting of the British Association at Dublin, of which body he was a prominent member from the time of its establishment. In 1837 he was elected president of the Royal Irish Academy, and was an honorary or corresponding member of the principal scientific academies of Europe and America. He died September 2, 1865, at his official residence, the observatory, near Dublin. He contributed numerous papers to the Transactions or journals of various learned bodies, and made some valuable scientific discoveries. In 1828 his Theory of Systems of Rays, which grew gradually out of earlier essays connected with contact of curves and caustics, was published by the Royal Irish Academy. In this treatise his celebrated prediction, on theoretical grounds, of the existence of conical refraction of a ray of light was given to the world. Reasoning on the properties of light, he came to the conclusion that under certain circumstances a ray, instead of being refracted in the ordinary way, should split up into a cone of rays; a phenomenon which was afterwards proved experimentally by Professor Lloyd to take place under the proper conditions. In 1834 his General Method in Dynamics was published in the Philosophical Transactions. In this work and that on Systems of Rays the whole of any dynamical problem is made to depend on a single function and its differential co-efficients. Another important treatise of his is Algebra looked on as the Science of Pure Time. He published also Memoirs on Discontinuous Functions, or Equations of the Fifth Degree, &c. But the foundation on which his fame most securely rests is the discovery or invention of the calculus of quaternions, an instrument of extraordinary power in the solution of intricate problems in mathematics and physics. His Lectures on Quaternions appeared in 1853, and in 1866 a posthumous work on the same subject entitled Elements of Quaternions. Sir William was not a dry mathematician merely, but was a man of wide and varied attainments, a contributor to general literature, and author of some poetical pieces which displayed both depth of thought and elegance of style. There is a Life of Sir William Rowan Hamilton by R. P. Graves (three vols., 1883–89), with an Addendum (1892).

HAMM, a town of Prussia, in the province of Westphalia, at the confluence of the Ahse with the Lippe. Its industrial establishments embrace large iron-foundries and machine-works, rolling mills and puddling-works, wire-works, agricultural implement works, &c. Pop. (1900), 31,371.

HAMMER, a well-known tool used by mechanics, of which there are various sorts; but almost all consist of an iron head fixed crosswise to a handle of wood. The forging of heavy articles has been greatly facilitated by the steam-hammer. See STEAM-HAMMER.

HAMMERFEST, a maritime town in Norway, in the bailiwick of Finmarken, on Hvalö (Whale Island), a bare, treeless, barren spot; lat. 70° 40′ N.; lon. 23° 42′ E. It is the most northerly town in Europe, and lies in a fine secure bay. The buildings are all of wood, among the chief being the churches, the town-hall, and the schools. The principal street was rebuilt after the fire of 1890. It carries on a lively trade, dried fish, and fish, seal, shark, and whale oil being the principal commodities. Fishing fleets leave regularly for Spitzbergen and the Kara Sea. Though within the Arctic circle, the winter is comparatively mild. The sun does not set from May 13 to July 29, and does not rise from Nov. 18 to Jan. 23. The town has electric light. Pop. 2300.

HAMMER-HEADED SHARK. See SHARK.

HAMMER-PURGSTALL, JOSEPH FREIHERR VON, an eminent orientalist, was born in 1774 at Gratz, in Styria, where his father held an office under government. He was educated in the Barbara Institute, Vienna, and afterwards at the Oriental Academy. When a very young man he took a share in the preparation of Meninsky's Arabic, Persian, and Turkish Lexicon, and in 1796 was appointed secretary to Freiherr von Jenisch, auditor of the oriental section of the ministry of foreign affairs. In 1799 he accompanied as interpreter to Constantinople the internuncio Freiherr von Herbert, who afterwards intrusted him with a mission to Egypt, where he collected various antiquities and manuscripts for the Imperial Library. He also accompanied, as interpreter and secretary, Sir Sidney Smith and Jussuf-Pacha in the campaign against General Menou, and in 1801 visited England by way of Malta and Gibraltar. On returning the following year to Vienna he again proceeded to Constantinople with Baron Stürmer as secretary of legation, and in 1806 to Moldavia as consular agent. There he remained only one year, after the lapse of which he returned to Vienna. In 1810, on the occasion of the marriage of Napoleon with Maria Louisa of Austria, he accompanied the latter to Paris, where he became intimate with Sylvestre de Sacy and other orientalists. He was again in France in 1815, employed in seeking for the oriental MSS. which had been carried off by the order of Napoleon from the Austrian collections. In 1817 he was appointed imperial councillor at the court of Austria, where he also held the post of interpreter. On succeeding to the estates of the Countess of Purgstall in 1835 he received the title of *Freiherr*. He died at Vienna on the 23rd of November, 1856. Among his numerous literary works may be mentioned: Constitution and Administration of the Ottoman Empire (two vols., Vienna, 1815–16); Constantinople and the Bosporus (two vols. Pesth, 1821); History of the Ottoman Empire (ten vols. second edition, Pesth, 1835–36); History of the Assassins; History of the Golden Horde in the Kiptshak; History of the Ilkhans; History of Persian Eloquence; History of Turkish Poetry (four vols. Pesth, 1836–38); History of Arabic Literature (Vienna, 1850–57); besides numerous translations from oriental authors, and contributions to various periodicals.

HAMMERSMITH, a municipal and parliamentary borough of London, about 6 miles W.S.W. of the London post-office, on the Great Western Road, along which the principal street extends. The other

streets were formerly narrow and irregular, but have of late years been much improved. Among the public buildings are the town-hall, the parish church, several other churches, and dissenting chapels, a large endowed school, named from its founder William Godolphin, the St. Paul's City Schools, the West London Hospital, &c. The Thames is here crossed by a magnificent suspension-bridge. Hammersmith became a parliamentary borough with one member in 1885. Pop. in 1891, 97,239; in 1901, 111,976.

HAMMOCK, a sort of swinging bed, especially used on board ships. A sailor's hammock is generally of hempen cloth, 6 feet long and 4 feet wide, gathered together at the two ends by means of a clew, and slung horizontally under the deck. There are about from 14 to 20 inches allowed between every two hammocks in a ship of war. In preparing for battle, the hammocks, with their contents, used to be taken upon deck, and fixed in various nettings, so as to form a barricade against musket-balls. The word is said to be of Caribbean origin, and the Caribs certainly make use of similar hanging beds. They are often used out of doors in warm weather by the luxurious of various countries.

HAMOON, Lake. See Seistan.

HAMPDEN, John, celebrated for his patriotic opposition to taxation by prerogative, was born in London in 1594, and in 1609 was entered a gentleman commoner at Magdalen College, Oxford. On leaving the university in 1613 he took chambers in the Inner Temple in order to study law; but the death of his father putting him in possession of an ample estate, he indulged in the usual career of country gentlemen, until the aspect of the times, and the natural weight of his connections and character, produced greater strictness of conduct, without any abatement of his cheerfulness and affability. He was cousin-german, by the mother's side, to Oliver Cromwell. He entered Parliament in the beginning of Charles I.'s reign as member for Grampound, and continued to sit in the House of Commons three times in succession as member for Wendover, and finally as member for Bucks. Although for some years a uniform opposer of the arbitrary practices in church and state, he acted no very distinguished part in Parliament. In 1636 his resistance to Charles' demand for ship-money (to use the language of Lord Clarendon) made him the argument of all tongues, especially as it was after the decision of the judges in favour of the king's right to levy ship-money, that Hampden refused to pay it. Being prosecuted in the Court of Exchequer, he himself, aided by counsel, argued the case against the crown lawyers for twelve days before the twelve judges; and although it was decided against him by seven of them to five, the victory, as far as regarded public opinion, was his. From this time he received the title of the *patriot Hampden*; and his temper and his modesty on this great occasion acquired him as much credit as his courage and perseverance. In the following year (1637) he was one of those who meditated emigration to America, which they were prevented from carrying out by an order in council detaining them. Henceforward he took a prominent part in the great contest between the crown and the Parliament, and was one of the five members whom the king, in 1642, so imprudently attempted, in person, to seize in the House of Commons. When the appeal was made to the sword Hampden acted with his usual decision, by accepting the command of a regiment in the parliamentary army, under the Earl of Essex. Prince Rupert having beaten up the quarters of the parliamentary troops near Thame, in Oxfordshire, Hampden eagerly joined a few cavalry that were rallied in haste, and in the skirmish that ensued on Chalgrove Field, received a wound which proved fatal six days after its infliction, on the 24th June, 1643. It is said that the king testified his respect for him by sending his own physician to attend him. His death was a great subject of rejoicing to the royal party, and of grief to his own. Clarendon sums up an elaborate character of this eminent leader by declaring that, like Catiline, 'he had a head to contrive, a tongue to persuade, and a hand to execute, any mischief'. But his character and conduct, from first to last, evince his conscientiousness, and he has taken his rank by acclamation on the one side, and tacitly on the other, high in the list of English patriots.

HAMPSHIRE, Hants, or Southamptonshire, one of the southern counties of England, on the English Channel, including also the Isle of Wight; area, 1,037,765 acres or 1622 square miles. This county is considered as one of the most agreeable and fertile in the kingdom; and it has, from the earliest time, supported a numerous population. The surface is pleasantly diversified with gently-rising hills and fruitful valleys, adorned with numerous seats and villages, interspersed with extensive woodlands. Nearly seven-tenths of the surface is under agricultural tenure, and the remainder is occupied with forests and tracts of heath. Of the total area of 1,038,000 acres about 70 per cent is under cultivation. Of the cultivated portion nearly 40 per cent is in permanent pasture, about 27 per cent is under corn crops, and about one-sixth is under green crops. The chief corn crop is oats, grown on about 72,000 acres; next come wheat and barley. The most important green crop is turnips, covering about 60,000 acres; the others include tares, mangolds, cabbages, and potatoes. In the parts bordering on Surrey the land is principally appropriated to the growth of hops, which cover about 2300 acres. Besides the products noticed Hampshire is famous for its wool, bacon, honey, and timber. Exclusive of the New Forest occupying almost the whole of its south-west angle, this county contains the Forest of Bere towards the south-east, and the woods or forests of Alice Holt, and Woolmer; the former extending northward from the Portsdown Hills, and the latter situated on the borders of Surrey and Sussex. This county is watered by several rivers, some of which rising in the north-east soon leave the county in their course towards the Thames; but the larger (including the Avon, Test, Itchin, &c.) cross it from north to south, and fall into the English Channel. In tracing the sea-coast from east to west we find several important indentations, to the first series of which belongs Portsea Island, on which is the town of Portsmouth; opposite to it, on the mainland, is Gosport, situated on the peninsula which terminates in the roadstead called Spithead, north of the Isle of Wight. Hence commences that arm of the sea, stretching to the north-west, named Southampton Water, navigable almost to its head for vessels of considerable burden. Further westward are the bays of Lymington and Christchurch. The manufactures are unimportant, having declined of late years. The principal are shalloon, serge, kerseys, and other woollens. Sea-fish are plentiful, and lobsters and other marine crustacea are taken off the coasts; and the rivers produce excellent trout. Hampshire, including the city of Winchester, the represented boroughs, and the Isle of Wight, sends twelve members to Parliament. The county is formed into five divisions, each of which returns one member: Winchester has one; Christchurch, one; Portsmouth, two; Southampton, two; and the Isle of Wight, one. It has one court of Quarter Sessions, and is divided into fourteen petty sessional divisions. Pop. in 1891, 690,086; in 1901, 798,756.

HAMPSHIRE, New. See New Hampshire.

HAMPSTEAD, a metropolitan municipal and parliamentary borough and suburb, 5 miles N.W. of London City. It is situated on the declivity of a hill, from which there is a most charming prospect of the metropolis and the adjacent counties. The heath which crowns the summit of the hill comprises about 280 acres, and is a most popular holiday resort. Hampstead is a favourite residential locality for the salubrity of its air and the beauty of its situation. The chief buildings include churches and chapels, town-hall in Italian style, public library, industrial schools, hospital, &c. It returns one member to Parliament. Pop. in 1891, 68,416; in 1901, 82,329.

HAMPTON, a village of Middlesex, situated 15 miles S.W. of London, best known from the neighbouring palace. The royal palace of Hampton Court is about 1 mile from the village. The original edifice, which consisted of five quadrangles, of which two only now remain, was built by Cardinal Wolsey in 1525, who presented it in 1526 to Henry VIII., by whom it was subsequently enlarged, and who formed around it a royal park or chase, which he inclosed and stocked with deer. A third quadrangle was added by Sir C. Wren for William III., who laid out the gardens and park in the Dutch taste. The palace, as it now stands, consists of three courts, the first of the age of Wolsey, the second of Henry VIII. after Wolsey's death, and the third, as abovementioned, of the age of William III. Hampton Court contains many valuable pictures by Holbein, Lely, Kneller, West, &c. The gardens comprise about 44 acres. The private garden presents a series of raised terraces, formal flower-plots, and long shady arcades, and contains a famous old and prolific vine. There are also a 'maze' and a 'wilderness' adjoining the palace. Hampton Court has been inhabited successively by Henry VIII., and his children; James I.; Charles I.; Cromwell; Charles II.; William III., and his queen; Queen Anne; and lastly, George II. On the 14th, 15th, and 16th of January, 1604, what is known as the *Hampton Court Conference* took place here on the petition of the Puritan ministers to King James I., between some of the leading divines of the section of the Church of England most strongly attached to episcopacy, and a few of the members of the Puritan or reforming party. By the composition of the conference (there being on the episcopal side, besides the Archbishop of Canterbury, eight bishops, five deans, and two doctors, and on the Puritan side only four representatives) the king sufficiently indicated what countenance he was disposed to allow to the aims of the Puritans, and the proceedings chiefly consisted of adulation of James on the part of the episcopal party, and browbeating of the Puritan members on the part of King James himself. A few alterations were made in the Prayer Book, and it was determined that a new version of the Bible should be undertaken, the result being the Authorized Version of 1611. Suites of apartments in Hampton Court palace are now set apart for persons of rank in reduced circumstances. The state apartments, picture-gallery, gardens, and home park are open to the public. In 1886 the palace suffered considerable damage by fire. Pop. of urban district in 1901, 6812.

HAMSTER (*Cricetus*), a genus of rodent animals, belonging to the family of the Muridæ, and closely allied to the rats, which they resemble in their dentition as well as in some other features. Like the monkeys they have their cheeks hollowed out into pouches which they use to convey grain to their holes; they have four toes and a tubercle on the fore-feet and five toes on the hind-feet; all the toes are armed with strong claws. The common hamster (*Cricetus vulgaris*, Cuv., *Mus Cricetus*, Linn.) has a length of from 10 to 12 inches without the tail, which is not more than 3 inches long. It is usually brownish-red or gray above, black beneath and on the legs, and white on the feet. But the colour varies very considerably, and sometimes varieties are found completely white. It is found from the Obi and the Caucasus chain to the Rhine, but seldom farther west than this river, or farther north than 60° lat. It is a very destructive animal on account of the quantity of grain which it stores up in its subterraneous cavern. This cavern or burrow is usually from 3 to 6 or even more feet underground; it is entered by a perpendicular opening, while another oblique passage serves as a means of exit. Communicating by passages with the central chamber of the burrow are several circular excavations on all sides. It is in these excavations that they remain torpid during the winter. Besides grain they also eat roots and sometimes even flesh. They are fierce animals, and defend themselves boldly even against the attacks of men. There are other species of hamster, all of them smaller than the common kind.

HANAPER, formerly an office in the English chancery, under the direction of a master, with a deputy and clerk. The clerk of the hanaper received all fines due to the king for seals of charters, patents, commissions, and writs. He attended also the keeper of the seal, and was custodier of all sealed charters, patents, &c. The Act 5 and 6 Vict. cap. ciii. transferred the duties of the hanaper office to other officials. The name is derived from the fact that the documents belonging to this office were kept in a sort of hamper (Low Latin, *hanaperium*).

HANAU, a town of Prussia, in the province of Hesse-Nassau, situated in a fertile district, at the confluence of the Kinzig with the Main, 13 miles E. of Frankfort, with which it is connected by railway. It is regularly built, very much after the manner of a Dutch town; and consists of straight, well-paved, and well-lighted streets, and of several handsome squares. It has several Protestant churches, a Roman Catholic church, a synagogue, an ancient castle and electoral palace (now belonging to the town), formerly the residence of the landgraves of Hessen-Philippsthal, a gymnasium, two old town-houses and a later one (1633), a theatre, orphanages, a real-school, &c. There are important manufactures of jewelry and gold wares, silver wares, tobacco, carpets, hosiery, gloves, paper, diamond-polishing establishments, machine-works, chemical-works, breweries, iron-foundry, &c. Near the town is a royal powder-factory, the largest in Germany. About the end of the sixteenth century many persons, driven by persecution from the Low Countries, took up their residence in Hanau, introducing manufactures which have scarcely ever since ceased to flourish. During the Thirty Years' War, Ramsay, a Scotchman, held the town for nine months against the imperialists (1635-36) till the siege was raised by the Swedes. In 1813 the French under Napoleon here defeated the Bavarians under General Wrede. Pop. (1895), 27,655; (1900), 29,847.

In the twelfth century Hanau was the capital of a county. On the extinction of the younger line of counts in 1730, part of the county fell to Hesse-Cassel and part to Hesse-Darmstadt, but in 1785 the whole came into the possession of Hesse-Cassel. In 1803 it was erected into a principality, which, after being seized by the French, was in 1809 included in the grand-duchy of Frankfort, with which it remained till 1813, when it was restored to Hesse-Cassel, whose fortunes it afterwards shared.

HAND, the part of the body which terminates the arm, the principal organ of touch and prehension. On account of the intimate relations subsisting between the hand and arm it will be convenient to treat of them both together, and we will therefore give a short general account of the upper, or, as it is called, thoracic limb, before proceeding to the particular subject of this article. What is called in popular language the arm consists of two parts connected by a joint at the elbow. The upper part is that to which, in scientific language, the term arm is restricted, the lower part being called the fore-arm. The bone of the arm is called the *humerus*, the upper extremity or head of which is inserted into a round shallow socket, called the *glenoid cavity*, in the scapula or chief bone of the shoulder. This articulation permits a greater variety of movement than any other in the human frame, which is due to the shallowness of the glenoid cavity and its rounded form. The lower extremity of the humerus articulates at the elbow with the *radius* and the *ulna*, the two bones of the fore-arm, the former being that which is attached to the outer and the latter that which is attached to the inner part of the elbow joint. At the upper end of the ulna there is a protuberance called the *olecranon*, which limits the backward movement by resting in a cavity of the humerus. The radius and ulna are joined at the lower end to the carpus or wrist, which unites the fore-arm to the hand. Eight bones of different and very complicated forms, firmly bound together by a large number of ligaments, constitute the carpus, which corresponds to the tarsus in the foot. Three of these form the articulation of the fore-arm, and a fourth is situated in the same row without forming part of the articulation. The other four bones are united to the five bones of the palm or *metacarpus*, to which the fingers are attached, there being only one bone in the second row of the carpus for the two bones of the metacarpus which correspond to the ring-finger and the little finger. These small bones are allowed a slight amount of movement on one another by means of joints. The fingers are composed of two phalanges in the thumb, and three in each of the other fingers. The first three bones of the carpus are grouped in such a manner as to form a convex surface, convex both from side to side and from before backwards. The separate bones are bound together by various ligaments, their articulating surfaces are cushioned with cartilage, and so form a surface for articulating with the lower end of the fore-arm, which is concave. On the posterior aspect the articulating surface of the carpal bones is more prolonged than in the front, permitting of over-extension of the hand on the fore-arm.

The deltoid, the great dorsal, great pectoral, and other less powerful muscles about the shoulder, give motion to the humerus. The humerus itself is surrounded by numerous muscles which bend or extend the fore-arm, and the chief of which are the biceps and triceps. The biceps muscle covers the front of the humerus, and is attached at its upper end at two different points to the scapula or shoulder-blade, and at its lower end to the inner side of the radius. It is the muscle which bends or flexes the fore-arm. The triceps covers the back part of the humerus, and is attached at its upper end at one point to the shoulder-blade and at other two points to the humerus, and at its lower end to the olecranon or protuberance of the ulna. Its contraction extends the fore-arm. Arising from the lower end of the humerus are some of the chief muscles of the fore-arm, which flex and extend the hand and fingers, and render the hand prone or supine, and also produce some degree of lateral movement of the hand. The pronator muscle is attached at its upper end to a projecting process on the inner side of the humerus, and at its lower end to the outer edge of the middle of the radius, so that by its contraction the radius is made to pass in front of the ulna, and the hand turned with the palm downwards. During this process the movement of the ulna is small compared with that of the radius. The supinator is the corresponding muscle which turns the hand with the palm upwards. It is attached at the upper end to a projecting process on the outer side of the humerus, and at its lower end to the outer border of the radius near its lower end. The mode in which the biceps is inserted in the radius gives that muscle also a tendency to supinate the hand while it flexes the fore-arm, and does do so unless counteracted by the pronator muscle. The strength of this tendency may be observed by pronating the hand as far as possible, and then flexing the fore-arm, when it will be found that the hand cannot be kept in the same position without some difficulty. The movements more peculiar to the hand are those by which the hand itself is flexed backwards, forwards, and sideways, and by which the thumb and fingers are moved in different ways.

The numerous muscles which determine these movements form a very complicated mechanism. It will be enough to mention the most important, those which serve to flex and extend the fingers. There are two muscles which flex all the fingers except the thumb. One of these is called the deep or perforating flexor of the fingers, because it passes down the front of the fore-arm underneath the other flexor, and then divides into four tendons, each of which passes through a slit in the corresponding tendons of the other flexor, and is then attached to the last phalanx of one of the last four fingers. The other flexor is called the superficial or perforated flexor, and after passing down the fore-arm and dividing in the way already indicated, is attached by four tendons to the second phalanges of the same fingers. The thumb and little finger have, besides, each a short and long flexor. The common extensor of the fingers arises from the exterior protuberance of the humerus, and divides at the wrist into four tendons, which pass under the annular ligament and are attached to the base of each of the three phalanges of the same fingers to which the two flexors are attached on the opposite side. The fore-finger and little finger have, in addition, each an extensor of its own, and the thumb has both a short and a long extensor. The tendons of the muscles of the hand are interlaced and bound together by bands and aponeurotic fibres, and from this results a more or less complete unity of action. It is sometimes difficult to make a movement with a single finger without the others taking part in it, as in executing instrumental music, for instance; but practice gives to these movements perfect independence. The mechanism of the movements of the hand has been made singularly clear by certain experiments of M. Duchenne of Boulogne, who has succeeded in distinguishing, by means of electricity, the action not only of different orders of muscles, but also of each particular one. Gerdy counts thirty-four distinct movements of the hand, and if we include the combinations of these different movements we shall reach a much higher number. The opposition of the thumb to the other fingers, alone or united, is of all these movements that which especially characterizes the human hand, by which alone it exists in its perfection. This action of the thumb results from its length, from the first metacarpal bone not being placed on the same plane as the other four, as is the case in the monkey, and from the action of a muscle—the long flexor of the thumb—peculiar to the human hand. This muscle

completes the action of the other motor of the thumb, and permits man to hold a pen, a graver, or a needle; it gives to his hand the dexterity necessary in the execution of the most delicate work. In repose the hand of man is presented in an attitude half opposed to the thumb; but it is not so in the monkey, even in the species most resembling man. It is opposable in these animals, but much less so than in man; and the five bones of the metacarpus being on the same plane, the fingers or toes can be placed flat upon the ground in walking, in which the four limbs always take part. Properly speaking, then, the hand belongs to man alone, and its conformation does not permit us to consider it as a normal organ of locomotion. It can by turns form itself into a plane, round itself into a cylinder, hollow itself into a gutter, make the fingers spread like so many diverging rays, and form, in the words of De Blainville, a compass with five branches, &c.; and lastly, it can reach every portion of the body.

The hand is essentially the organ of touch and of prehension. It moulds itself to a body to ascertain its form; it comes to the aid of the eye in completing or rectifying its impressions, and in some cases even supplies its place. Thus the finger of the physician perceives on the surface of an organ the slightest inequality in relief; and the hand of Michael Angelo followed with enthusiasm the contour of the antique torso, which the eyes of the great artist could no longer contemplate. The functions of touch devolve principally upon its anterior or palmar face. The nervous papillæ with which it is provided abound specially at the ends of the fingers, where they form furrows in elegant curves under the epidermis. The tendons in it are very numerous, and bound together by multiplied connections. Strong aponeuroses, or tendinous expansions, and sheaths, through which the tendons slide, make the skin compact, and combine to give unity to the general movements of the different parts of the organ, and independence to partial ones. A layer of adipose tissue, very close in texture, protects, without lessening its power or its delicacy, the network of muscles, vessels, and nerves, with which this remarkable organ is equipped.

Nothing can give a more complete idea of the perfection of the mechanism of the hand than the execution of instrumental music. The agility and flexibility of the hands, the concordance and independence of their movements, are remarkably displayed in the playing both of the violinist and the pianist. A skilful pianist produces about 640 notes a minute in medium time, and 960 in extremely quick time. These numbers give us an idea of the rapidity of movement which can be attained by the hand of man.

HAND, in heraldry. A bloody hand in the centre of an escutcheon is the badge of a baronet of Great Britain.

HANDCUFFS, an instrument formed of two circular pieces of iron, each fixed on a hinge on the ends of a very short iron bar, which, being locked over the wrists of a malefactor, prevents his using his hands.

HANDEL (properly HAENDEL), GEORGE FREDERICK. This celebrated composer was a native of Halle on the Saale, in Prussian Saxony, where his father practised with considerable reputation as a physician and surgeon. He was born on the 23rd of February, 1685. His father, intending him for the law, discouraged as much as possible the strong passion which he evinced early in life for the science of music. But although he was forbidden the use of musical instruments, the young musician contrived to hide a small clavichord in a garret, where he amused himself during great part of the night after the rest of the family had retired, and made such progress that, when at the age of seven he accompanied his father on a visit to the court of Saxe-Weissenfels, where his brother held a subordinate situation in the household, he played on the church organ with such power and effect that the duke, who accidentally witnessed his performance, used his influence successfully with his father to permit him to follow his inclination. He was accordingly placed under the tuition of Zachau, organist of the cathedral, and was soon so far advanced in the practical part of the science as to be able to officiate occasionally as deputy to his instructor, while his theoretical proficiency enabled him to compose a service or spiritual cantata weekly for nearly three years. At the age of fourteen (1698) he went to Berlin, where at that time the opera under the direction of Buononcini and Attilio was in a very flourishing condition. Attilio became his teacher and friend, and the 'Great Elector,' Frederick William, offered him the means of paying a visit to Italy. This seemingly advantageous offer he, however, declined, and after a short residence at Halle repaired in 1703 to Hamburg, then celebrated for the excellence of its musical performances, and procured an engagement in the orchestra at the opera there. On the 30th of December, 1704, Handel brought out his first opera, Almira, which in the February following was succeeded by his Nero, and subsequently by Florindo and Daphne. Having at length saved enough to warrant him in making a journey to Italy, he proceeded in succession to Florence, Venice, Naples, and Rome, in which latter capital he formed an acquaintance with Corelli at the house of Cardinal Ottoboni. In Italy he composed the operas Rodrigo and Agrippina, and the first form of the serenade Acis and Galatea. On his return to Germany in 1710 he entered the service of the Elector of Hanover, afterwards George I. of England, as chapel-master; but having received pressing invitations from several of the British nobility to visit London, he, with the permission of that prince, set out for England, where he arrived in the latter end of 1710. On the occasion of this first visit to England he composed the opera Rinaldo. He shortly after returned to Hanover, but at the end of two years again received permission to visit England. At the time of his arrival in London the negotiations for the Peace of Utrecht were just about to be concluded, and Handel was invited by Queen Anne to compose a Te Deum and Jubilate in celebration of the peace. But this act of complaisance to Queen Anne was so distasteful to the Elector of Hanover that Handel did not venture to return, but remained in England on an income of £200 a year allowed him by the queen. He was, in consequence, on the accession of his royal patron to the throne of Great Britain in 1714, in much disgrace, till the good offices of Baron Kielmannseck restored him to favour. His pension was doubled, and other £200 were added to it when he undertook the instruction of the young princes. From 1715–18 Handel resided with the Earl of Burlington, and then quitted that nobleman for the service of the Duke of Chandos, who entertained him as chapel-master to the splendid choir which he had established at his seat at Cannons. For the service of this magnificent chapel Handel produced those anthems and organ fugues which alone would have been sufficient to immortalize him. When the Royal Academy of Music was instituted by some of the leading noblemen of England, this great composer, whose fame had now reached its height, was placed at its head; and this, for a short period, may be considered as the most splendid era of music in England. The warmth of his own temper, however, excited by the arrogance

and caprice of some of his principal Italian singers, gave birth to many violent quarrels; and public opinion becoming to a certain extent enlisted in favour of his opponents, and especially of his rival, the able musician Buononcini, his popularity began to wane, and after nine years' duration the Academy (really a joint-stock company) was dissolved (1728). Handel then combined with Heidegger, and started a new operatic company, which performed first at the King's Theatre, afterwards at Covent Garden. But a rival company to Handel's was afterwards started, and the result was that much money was lost by both, Handel's loss amounting to some £10,000. The operas which he had composed up to this date (1735), from the institution of the Academy of Music, were Radamisto, Ottone, Giulio Cesare, Floridante, Flavio, Tamerlano, Rodelinda, Alessandro, Scipione, Ricardo I, Tolomeo, Siroe, Lotario, Parthenope, Poro, Orlando, Sosarme, Ariadne, Ezio, Ariodante, and Alcina. Among other pieces should be mentioned his first English oratorio, Esther, and his delightful pastoral or serenata, Acis and Galatea. In 1736 his famous setting of Dryden's ode, Alexander's Feast, was performed with brilliant success. The losses and anxieties of the past few years had had so injurious an effect on Handel's health that he was ordered by his physicians to visit the baths at Aix-la-Chapelle. The use of the waters had a wonderfully restorative effect upon him, and he soon returned to London, and composed several new operas and other pieces. His last opera was performed in 1741. Handel had by this time begun to devote himself chiefly to music of a serious nature, especially the oratorio. The approval which his first works of this kind (Esther, already mentioned, Deborah, 1733, Athalia, 1733) had met with encouraged him to new efforts; and he produced in succession Saul, Israel in Egypt, and the Messiah. The last-mentioned, which is his chief work, was brought out at Dublin in 1742, Handel having visited this country on the invitation of the Duke of Devonshire, then lord-lieutenant. This sublime composition had been composed the previous year, in the incredibly short period of twenty-three days. After an absence of nine months, which had turned out most profitably both to his purse and fame, Handel returned to London, and had the gratification to find that his oratorios were received at Covent Garden Theatre with the greatest approbation by overflowing audiences—the Messiah, in particular, increased yearly in reputation. Before it was given, however, a new oratorio, Samson, was produced (1743), and there next followed Joseph and his Brethren (1744), Belshazzar (1745), Judas Maccabæus (1747), Joshua (1748), Solomon (1749), and Jephthah (1752). Some time previously to his decease he was afflicted by nearly total blindness; but this misfortune had little effect on his spirits, and he continued not only to perform in public but even to compose. His own air, however, Total Eclipse, from the oratorio of Samson, is said always to have affected and agitated him extremely after this melancholy privation. On April 6, 1759, he was, as usual, at his post in the orchestra, at a performance of the Messiah, but he then had an attack of faintness, and he expired, after a very short illness, on the 14th of the same month.

Handel's habits of life were regular; and although in his contests with rivals he lost at one time the whole of his savings, yet he left money at his decease. His appetites were coarse, his person large and ungainly, his manners rough, and his temper even violent; but his heart was humane, and his disposition liberal. His early and assiduous attention to his profession prevented him from acquiring much literary information, but he spoke several modern languages. His musical powers can hardly be estimated too highly. In boldness and strength of style, and in the combination of vigour, spirit, and invention in his instrumental compositions he has never been surpassed. His choruses have a grandeur and sublimity which have never been equalled. Yet a singular fact in regard to him as a musician is that in some of his works he shows himself as an unscrupulous plagiarist—a fact of which various explanations and palliations have been attempted. He never married. He was buried in Westminister Abbey, where a monument by Roubillac was erected to his memory. His music is more popular in England than in any other country. The best life of him in English is that by Rockstro. See also the articles in the Dictionary of National Biography and Grove's Dictionary of Music.

HANDICAPPING, in horse-racing and various other games and sports, a system of equalizing the chances of victory in favour of each of the competitors, so far as the chances can be determined beforehand. In horse-racing this is done by making the best horses carry heavier weights than the inferior ones, the amount of weight being always proportioned to the racing qualities which the horse has been ascertained to possess. In foot-racing the same object may be effected by allowing inferior runners to start somewhat in advance of the others, so that they have less ground to get over; in chess-playing, by the stronger player giving odds, that is, giving up one or more of his men at the beginning of the game, sometimes allowing the weaker player also the first move; and so in other cases.

HANDS, LAYING ON OF. This rite, as a token of blessing, or the communication of spiritual gifts, or of something else which could not be literally delivered into the hands of another, has been in use from the earliest times. It occurs in Scripture as a patriarchal usage, appropriate and becoming perhaps rather than strictly religious. Jacob laid his hands upon the heads of Joseph's children when about to bestow upon them his peculiar blessing (Gen. xxviii. 14) precisely as in later times Christ laid his hands on the little children who were presented to him for *his* blessing (Mat. xix. 15). In like manner, and with a nearer approach to a religious service, Moses was instructed before his departure to lay his hand upon Joshua (Num. xxvii. 18). So also this rite was used in the case of the blasphemy of the son of the Israelitish woman, to signify that the guilt which through him had been brought upon the whole congregation was solemnly transferred to him to whom it properly belonged. The same rite formed an essential part of the ritual of animal sacrifice among the Jews, the offerer being required to lay his hands on the victim while still alive. In the early church this rite was used in benediction, absolution, the unction of the sick, and the reconciliation of penitents as well as in ordination and confirmation. The rite is still retained by most western churches in ordination, and in the Roman Catholic, Anglican, and Lutheran churches also in confirmation. In the Roman Catholic Church the elevation of the hands is substituted for the actual laying on of hands in absolution.

HANDSWORTH, an urban district and parliamentary division of Staffordshire, England, a north-west suburb of Birmingham, with an ancient decorated church (restored), containing a statue of James Watt and a bust of Murdock by Chantrey, and a monument to Boulton by Flaxman; public offices, with free library; a Wesleyan theological college; a technical school; &c. Pop. in 1891, 82,756; in 1901, 52,921; of parl. div. (1901) 12,254.

HANDWRITTING, in law. The best means by which the handwriting of a person can be proved, where such handwriting is not acknowledged by the writer himself, is by the evidence of witnesses who saw the writing executed. Where such direct evidence cannot be obtained the best method that can be adopted is to call witnesses who are acquainted with the handwriting of the person who is supposed to have written the document in question to declare their belief that the writing is his; but evidence of this nature is not by Scotch law deemed sufficient of itself in criminal cases. The weakest sort of evidence is where the handwriting in dispute is compared by the witnesses with some other writing admitted by the judge to be the genuine writing of the person who is supposed to have written the former, and their opinion regarding it given to the court and the jury. This evidence is nevertheless allowed both in England and Scotland in criminal as well as in civil cases.

HANG-CHOW, a large city in China, capital of the province of Che-kiang, on a plain at the southern terminus of the Imperial Canal, and within 2 miles of the Tsien-tang-kiang, about 40 or 50 miles from its mouth, nearly 100 south-west of Shanghai. It is a strongly fortified town of oblong form, surrounded with high well-built walls about 8 miles in circuit, inclosing many large vacant spaces. The streets are narrow, but well paved and clean, and throughout the town are numerous triumphal arches, monuments to great men, and gorgeous Buddhist temples. The shops and warehouses are said to be equal to the best in London, both as regards their size and the quantity and beauty of the goods displayed in them—silks, furs, gold and silver ornaments, jade-stones, and curiosities of all kinds being leading articles. More than 100,000 persons are said to be employed in the silk manufactures alone. Among the other industries flourishing in this city are the weaving of cotton, manufacture of tapestries, carving in ivory, the making of lacquered ware, fans, and screens, &c. &c. The houses are generally of but one story high. A large portion of the inhabitants reside in the suburbs, and in boats on the waters around them. The governor-general of Che-kiang and Fo-kien resides in this city, and also the governor of the province; who, with their courts and troops, in addition to the great trade passing through, render it one of the most important and richest cities in China. The river, opposite the city, is about 4 miles broad at high-water, and is crowded with vessels of all descriptions, being the channel by which vast quantities of merchandise are received from and exported to the southern provinces. The Lake of Si-hou, close by the city, is celebrated for its natural and artificial beauties, which make the district one of the most striking in the whole of China. Hang-Chow is the celebrated *Kinsai* of Marco Polo —the capital, in his time, of Southern China. It was captured by the Taiping rebels in 1861, and deserted by all its rich or respectable inhabitants. For three years, during the rebels' occupation, the place was impoverished, so that very little produce or merchandise of any value was left in it; while the unfortunate people who remained were plundered and made to work as slaves for their task-masters unless they took arms in their cause. On the suppression of that rebellion a disciplined force of Chinese, under the command of French officers, united with the Imperialist troops, recaptured the city on the 31st March, 1864. Since then the place has been gradually recovering itself. By the treaty of Shimonoseki (1895) it was opened to foreign trade. Pop. estimated at 700,000.

HANGING, as a mode of execution. See CAPITAL PUNISHMENT.

HANKOW (Mouth of the Han), a town and river-port of China, in the province of Houpe, at the junction of the Han with the Yang-tse-kiang, 688 miles above the mouth of the Yang-tse, which is navigable for large vessels up to the town. On the opposite bank of the Han is Hanyang, on the other side of the Yang-tse is Wuchang, the three together forming one immense city. In addition to that within the town there is a large floating population, the Han being as densely crowded with junks as it is possible to pack them for about half a mile above its mouth. In 1857 this city fell into the hands of the Taipings, who so completely demolished the shops and houses, after rifling them of their contents, that they scarcely left one brick standing upon another. The port was opened to foreign trade by the Treaty of Tientsin, ratified in 1860; and of all the ports added at that date it has most fully realized the expectations of traders. It has now become the chief emporium of trade for the tea districts in the central provinces, which formerly sent their produce for export to Canton. On the opening of this port the wealthy native merchants left Canton and settled here, together with crowds of traders of all kinds. At first the British residents built warehouses and rented Chinese residences in the native town; but as Lord Elgin had negotiated for a concession of about 90 acres of land apart from Chinese jurisdiction, they afterwards moved to a spot below it, which has been laid out in streets, like an English town. The residents of the British concession are formed into a municipality, with a council empowered to levy taxes. There are also German and other settlements. The foreign trade of this port has become one of the most important in China. The imports are brought almost exclusively from Chinese ports (about one-half from Shanghai), and consist partly of foreign produce, such as cottons, woollens, and opium; partly of native produce, such as tea, silk, &c. In 1903 the imports were £11,823,302; exports, £10,204,715. Pop. 800,000.

HANLEY, a municipal, parliamentary, and county borough of North Staffordshire, England, pleasantly situated on rising ground near the Trent, 18 miles north by west of the county town of Stafford. As a parliamentary borough it includes also the municipal borough of Burslem, about 2 miles distant. It contains several churches, a market-house, a handsome town-hall built of brick, a theatre, music-hall, the Potteries Mechanics' Institution, the North Staffordshire Technical and Art Museum, a government school of art, national and board schools, a public library, public baths, &c. A hundred years ago Hanley was merely a collection of a few humble dwellings, but it is now the chief town of the Potteries district. The inhabitants are chiefly employed in the china and earthenware manufacture; but there are also iron-furnaces, foundries, brick-works, and several important collieries. Hanley became a parliamentary borough, returning one member to parliament, in 1885, having been a municipal borough since 1857. Pop. in 1891, 54,946; of parl. bor. 86,946; of county bor. in 1901, 61,524.

HANMER, SIR THOMAS, was born in 1677 in Flintshire, and succeeded his uncle in his title and the family estate of Hanmer. Returned in 1701 to the House of Commons as member for Thetford, he was in 1714 chosen speaker of the House of Commons. This distinguished office he filled during the remainder of his parliamentary career. Towards the close of his life he withdrew altogether from public business, and occupied himself with literature, one result being a corrected and illustrated edition of Shakspere's dramatic works in six quarto vols., published in 1744. He died in 1746.

HANNAY, JAMES, a Scotch man of letters, son of a banker of Dumfries, where he was born in 1827; died at Barcelona, Jan. 9, 1873. At an early age he entered the navy, and during the campaign of 1840 in Syria he was present at many interesting scenes, of which he has given an account in his writings. In 1845 he quitted the navy, and betook himself to London to follow out his literary tastes, and was at first reporter to the Morning Chronicle. He continued to reside chiefly in London, employing himself in making contributions to various periodicals, and publishing separate works, chiefly novels, at intervals till 1860, when he removed to Edinburgh as editor of the Edinburgh Courant, the Tory organ of that city. In 1864 he resigned this post and returned to London, and on the 13th of July, 1868, he was gazetted as British consul at Barcelona. He became well known by stories and novels, the best of which are Singleton Fontenoy (1850) and Eustace Conyers (1855). The latter was translated into German. He is also the author of a course of lectures on Satire and Satirists (delivered in London in 1853), Three Hundred Years of a Norman House, Studies on Thackeray, and a Course of English Literature.

HANNIBAL, a town in the United States, in Marion county, Missouri, on the right bank of the Mississippi, on four lines of railway, 85 miles N.N.E. of Jefferson City. Its manufactures and industries embrace machinery, railway wagons, iron and steel, tobacco, &c., and it carries on a large lumber industry. Pop. (1900), 12,780.

HANNIBAL, or ANNIBAL, son of Hamilcar Barca, born B.C. 247. At the age of nine years his father, whom he was eager to accompany in the war against Spain, made him swear at the altar eternal hatred to the Romans. He was a witness of his father's achievements in Spain; but Hamilcar having fallen in battle in Lusitania, in 229 B.C., and his son-in-law Hasdrubal having been appointed to succeed him, Hannibal returned home. At the age of twenty-two he returned to the army at the request of Hasdrubal. The soldiers perceived in him the spirit of Hamilcar, whom they had so highly esteemed; and in three campaigns his talents and his courage were so conspicuous that the army, on the murder of Hasdrubal in 221, conferred on him the chief command by acclamation. Faithful to his early vow, the young general of twenty-six years soon manifested his determination to seize whatever opportunity might offer itself of commencing hostilities with Rome. This object was effected in 219 B.C. by laying siege to Saguntum, a town which had concluded an alliance with that city. In eight months Saguntum fell. The Romans, alarmed by the fate of this city, sent ambassadors to Carthage to demand that Hannibal should be delivered up. The demand being refused, they declared war. Hannibal raised a powerful force, and conceived the bold design of attacking the Romans in Italy. After providing for the security of Africa, and having left his brother Hasdrubal with an army in Spain, he began his march with 90,000 foot-soldiers, forty elephants, and 12,000 horsemen, traversed Gaul in the depth of winter with incredible rapidity, and reached the foot of the Alps. In nine days he crossed these mountains, probably by the pass leading over the Little St. Bernard. Of the troops with which he had set out, however, he had now only 20,000 foot-soldiers and 6000 horse remaining, and these were little more than skeletons. But his courage remained unshaken, and his only alternative was victory or death. The conquest of the Taurinians and the capture of their chief city secured him a supply of provisions, and encouraged the people of Cisalpine Gaul to join him. These auxiliaries would have been still more numerous had not Publius Scipio approached by forced marches at the head of a Roman army, which had landed at Pisa. On the banks of the Ticinus the armies engaged, and a charge of the Numidian horse left Hannibal master of the field (218 B.C.) Scipio avoided a second battle, and retreated beyond the Trebia, leaving the strong town of Clastidium in the enemy's hands. Meanwhile Sempronius arrived with a second army, which held the Carthaginian leader in check for a while; but Hannibal soon provoked his impetuous adversary to an engagement, disposed an ambuscade near the Trebia, and surrounded and destroyed the Roman forces. The Romans lost their camp and 26,000 men. Hannibal now retired to winter-quarters among his allies in Cisalpine Gaul; and at the opening of the next campaign (217) he found two new armies awaiting his approach in the passes of the Apennines. He determined to engage them separately, and destroy Flaminius before the arrival of his colleague. He deceived him, therefore, by feigned marches, crossed the Apennines, and traversed the Clusian marsh. For four days and nights the Carthaginians were marching through water. Even Hannibal, who had mounted the only remaining elephant, saved himself with difficulty, and lost an eye in consequence of an inflammation. He had scarcely regained firm footing when he employed every means to compel Flaminius to a battle. He wasted the whole country with fire and sword, and feigned a march to Rome; but suddenly formed an ambush in a narrow pass surrounded by almost inaccessible rocks. Flaminius, who inconsiderately followed him, was immediately attacked; a bloody engagement took place near the Lake Trasimenus, in which Roman valour was overcome by artifice and superior skill. Assailed on every side, the Roman legions were cut in pieces without being able to display their columns. Enriched with the spoils of the conquered, Hannibal now armed his soldiers in the Roman manner, and marched into Apulia, spreading terror wherever he approached. Rome, in consternation, intrusted her safety to Fabius Maximus, the dictator, who determined to exhaust by delay the strength of the Carthaginians. He attacked Hannibal with his own weapons, and hung upon him everywhere without attempting to overtake him, convinced that the Carthaginians could not long hold a desolated territory. These were led by their general into the plains of Capua, with the design of separating the terrified cities from their alliance with the Romans, and drawing down Fabius from the mountains. But Hannibal suddenly found himself in the same toils in which Flaminius had perished. Shut up between the rocks of Formiæ, the sands of Lecsternum, and impassable marshes, he was indebted for his safety to a stratagem. Having collected a thousand oxen, and fastened burning torches to their horns, he drove the furious animals at midnight into the defiles which were guarded by the Romans. Panic-struck at the terrible sight, they abandoned the heights, and Hannibal forced his way through their ranks. The Romans, dissatisfied with the delay of Fabius, now made Minutius Felix, master of the horse, his colleague in the dictatorship. Eager for combat, he fell into an ambush at Geronium, and would have perished but for the aid of Fabius. After this campaign the other Roman generals seemed unwilling to trust anything to chance, and imitated the delay of Fabius. Hannibal saw with grief his army slowly wasting away, when the new consul Terentius Varro, an inexperienced and presumptuous man, took the command of the legions. Hannibal had occupied Cannæ, and reduced the Romans to the necessity of risking an engagement (216). The two armies were drawn u

in presence. Paullus Æmilius, the colleague of Varro, wished to put off the battle, on account of the disadvantageous position of the Romans; but Varro chose the day of his command, gave the signal for the attack, and the Roman army was destroyed. (See CANNÆ.) Hannibal now marched to Capua, which immediately opened its gates. The three following campaigns—those of 215, 214, and 213—were comparatively unimportant. In 215 he sustained, at the hands of Marcellus, a repulse before Nola—the first check which he had received in the open field. In 212 B.C. he made an important acquisition in the capture of Tarentum, which he had been previously watching for two years; but this gain was only partial, as the citadel still remained in the hands of the Romans. The gain was besides counterbalanced by the loss of Syracuse in Sicily, which had espoused the Carthaginian cause, but fell in the same year as Tarentum. The possession of Capua was likewise endangered. That city was invested by two consular armies, and was on the point of surrendering. Hannibal hoped to save it by a bold diversion. He marched to Rome, and encamped in sight of the capitol, B.C. 211; but the Romans were not thus to be discouraged: Capua fell. This success gave the Romans a decided superiority, and nearly all the people of Italy declared in their favour. Held in check by the consul, Claudius Nero, Hannibal could not effect a union with his brother Hasdrubal, who had set out for Spain with reinforcements, but after having passed the Apennines was attacked and defeated by Nero on the Metaurus in 207. Hasdrubal himself fell, and his bloody head was thrown into the camp of Hannibal. The latter then retired to Bruttium, where, surrounded with difficulties, he yet maintained the contest with inferior forces against victorious armies. But Scipio now carried the war into Africa, and made Carthage tremble; and Hannibal was recalled to defend his country. He reluctantly embarked his troops, and in 203 left the country which for sixteen years he had held in spite of all the efforts of Rome. He landed at Leptis, gained over a part of the Numidians, and encamped at Adrumetum. Scipio took several cities, and reduced the inhabitants to slavery. Pressed by his countrymen to come to a decisive engagement, Hannibal advanced to meet him, and in 202 encamped at Zama, five days' journey from Carthage. The two generals had an interview, and Hannibal proposed terms of peace, but in vain. Hannibal was defeated; 20,000 Carthaginians were left upon the field, and as many more taken prisoners. Hannibal fled to Adrumetum, rallied the fugitives, and in a few days collected a new army capable of checking the conqueror's progress. He then hastened to Carthage, and declared to the senate that there was no safety but in peace, and persuaded that body to accede to the terms offered. The negotiations were not completed, however, till the year following, B.C. 201.

Thus ended the bloody contest of eighteen years, doubly fatal to Carthage, which was at once stripped of her former conquests, and of all hope of new ones, by the loss of her fleet. Hannibal, nevertheless, still retained his credit, and was made commander-in-chief of an army in the interior of Africa. But the partisans of Hanno, his bitterest enemy, continued to persecute him, and accused him to the Romans of maintaining a secret correspondence with Antiochus, king of Syria, with the design of lighting anew the flames of war. Ambassadors were accordingly sent to Carthage, to demand that he should be delivered up. He saved himself, however, by fleeing to Cercina, and thence to Tyre, where he was received with the greatest honours. He afterwards went to Ephesus, to the court of Antiochus, who was then on the point of commencing a war against the Romans. Here also Hannibal was eagerly welcomed, all the more so because his services were likely to confer great benefit on the King of Syria in his war with the Romans. Hannibal strongly advised that the war should be carried into Italy, and requested of Antiochus an army to do this. But the latter refused to take the advice, and Hannibal did not receive the command that he desired. He was indeed appointed to the command of the Syrian fleet, and attacked the Rhodians, who were allies of Rome; but, owing to the treachery of one of his officers, he was forced to retreat. Antiochus himself was led by a series of misfortunes and errors, which culminated in the defeat at Magnesia, B.C. 190, to conclude a disgraceful peace, one of the terms of which was that Hannibal should be delivered up. Hannibal was again obliged to flee, to escape being delivered up to the Romans, and went to the court of Prusias, king of Bithynia, who was animated by the same spirit of hostility against the Romans. He was the soul of a powerful league formed between Prusias and several neighbouring princes, against Eumenes, king of Pergamus, an ally of Rome, took the command of the military force, and gained several victories by land and sea. Notwithstanding these advantages Asia trembled at the name of Rome; and Prusias, to whom the senate had sent ambassadors to demand the person of Hannibal, was on the point of complying with the requisition, when Hannibal prevented the disgrace by swallowing poison, which he always carried about in his ring. He died B.C. 183.

HANNO, a Carthaginian navigator, who made a voyage on the western coast of Africa, of which he has left a description. The purpose of this voyage was to make discoveries for the benefit of commerce, and to settle colonies, of which he established six on the coast of Marocco, whence he continued his voyages of discovery. From his description he probably proceeded as far as the coast of Guinea; for his accounts of the people he describes are applicable to the negroes of that country, and the two large streams containing crocodiles and hippopotamuses correspond to the rivers Senegal and Gambia. The period at which Hanno lived is not known. Some writers make him as early as Hesiod, or the ninth or eighth century B.C., while Falconer and others place him with more probability about 570 B.C. The Periplus of Hanno is the Grecian translation of the relation of his voyage. See Fischer's De Hannonis Carthaginiensis Periplo (Leipzig, 1893).

HANOVER (Ger. *Hannover*), formerly a kingdom in the north-west of Germany, now a province of the Kingdom of Prussia, and bounded north by the German Ocean and the duchies of Holstein and Lauenburg, from which it is separated by the Elbe; north-east by Mecklenburg-Schwerin; east by Prussia and Brunswick; south by Prussian Saxony, Hesse-Cassel, and Rhenish Prussia; and west by Holland; lat. 51° 18′ to 53° 52′ N.; lon. 6° 40′ to 11° 35′ E. It is of very irregular shape; and, by the interjection of the Duchy of Oldenburg in the north, and of a long irregular belt of Brunswick in the south, is divided into three distinct portions—the first, and far largest, forming Hanover proper, situated on the east, and tolerably compact; the second on the west, and separated from the former by Oldenburg and Rhenish Prussia, except at one spot, where the continuity is maintained by a narrow tract, not more than 6 miles wide; and the third in the south, completely isolated from the other two. Besides these three principal, there are three minor portions, all in the south, and so small as not to require separate notice; and a range of sandy islands lining the coast. Total area (including the Prussian Jadegebiet, acquired from Oldenburg

in 1853, and joined to the province of Hanover in 1873), 14,857 square miles; capital, Hanover. Within the territory are included part of Brunswick and the free town of Bremen. It is divided into six regierungsbezirke or districts, whose areas and population, according to the census of 1st December, 1900, are given in the following table:—

Regierungsbezirke.	Area in sq. m.	Population.	Chief Towns.
Hanover.....	2,241	647,908	Hanover.
Hildesheim.....	1,990	526,758	Hildesheim.
Lüneburg.....	4,488	472,598	Lüneburg.
Stade	2,560	375,017	Stade.
Osnabrück.....	2,418	328,600	Osnabrück.
Aurich	1,160	240,058	Aurich.
Total.....	14,857	2,590,939	

Physical Features.—The surface in the south is covered by the Harz Mountains, some of whose summits there attain a height of more than 3000 feet; but all the rest of the country belongs to the west part of the great plain which stretches east across Prussia and Russia, and only terminates at the foot of the central plateau of Asia. In Hanover this plain, after free of the north slopes of the Harz, subsides into an extensive, and often dreary, monotonous flat, with a gentle slope to the North Sea, to the basin of which it wholly belongs. The only exception to the general flatness is caused by branches of the Harz, of moderate height, one of which stretches in a N.N.W. direction, and forms the watershed between the Ems and the Weser. Of these two rivers the former traverses the western portion of the province south to north, while the latter runs north-west through the eastern portion, and drains the greater part of it, either directly, or by its combined tributaries the Leine and Aller; the only other river of consequence is the Elbe, which forms the boundary of a considerable portion of the province, but is not augmented within it by any important tributary. The Harz Mountains are rich in minerals, which have long been worked to a great extent, the produce including a little gold, besides silver, zinc, copper, and iron. A branch of the Harz, between the Leine and Weser, produces both coal and lignite; and in several quarters rock-salt is found in large quantities. In the north of the province there are large peat-beds, which supply most of the fuel used in those parts, and even furnish considerable quantities for export to the south, as well as to Hamburg, Bremen, &c.

Agriculture.—In the low alluvial flats the soil is remarkably rich, but usually so overcharged with moisture that it cannot be safely brought under the plough, and is much more profitably employed by being allowed to remain in natural, or formed into artificial, meadows, which yield heavy crops of hay, or feed large numbers of cattle of a very superior description. When the ground attains a higher elevation the soil often consists either of a thin vegetable mould on a substratum of sand, so poor as often to be left in a state of nature with its covering of heath, or of deep beds of peat. But, after deducting these two classes of soil, there remain extensive tracts of arable land, amounting to one-fourth of the whole surface, of good medium fertility, and so industriously cultivated as to produce more corn than is required by the home consumption. Flax also, for which much of the soil is admirably adapted, is extensively cultivated, and forms an article of export, especially in the form of yarn. The keeping of bees is very generally practised on the moors. Forests occupy nearly one-sixth of the whole surface. They consist of hard wood and pine in nearly equal quantities, and are extensively used in smelting.

Manufactures and Trade.—The extent to which mining operations are carried on in the Harz has been already mentioned. They form, along with agriculture, highly important branches of national industry. Manufactures, formerly of little importance, have made great advances in modern times, especially in the capital itself, and in other towns in the south of the province, such as Osnabrück, Hildesheim, Göttingen, Hameln, &c. The making of linens and woollens, the former to a large extent still a domestic industry, has long been actively pursued; the cotton manufacture is a more modern industry, but there are now some large mills engaged in spinning and weaving. Other manufactured goods include leather, paper, tobacco and cigars, india-rubber and gutta-percha goods. Machinery and iron goods employ a number of hands, as also beet-root sugar, oil, chemical products, beer, and spirits. Hanover has not much of its own produce to export, and is consequently very much restricted as to imports on its own account. It possesses several ports, among which are Emden, Geestemünde, and Harburg, but Bremen is really the chief port for Hanover.

People.—Taken as a whole, Hanover is very thinly peopled, and in proportion to its extent of surface has much fewer towns of importance than any other country in Germany. The inhabitants are generally of Saxon origin, except in the west, where they have a common origin with the Dutch, and are of Frisian extraction. They are simple, temperate, industrious, and patient; submitting, almost without a murmur, to live on the humblest fare, and give themselves little concern with political arrangements. The educated classes, of course, speak the ordinary written language, but the lower orders generally speak Low German. The great majority of them are Protestants of the Lutheran persuasion. The Roman Catholics do not exceed one-seventh of the whole, and are almost entirely confined to the districts of Hildesheim and Osnabrück.

Government.—This, previous to its annexation to Prussia in 1866, was a hereditary monarchy, in which the Salic law was in force. The greater part of the population seemed readily to acquiesce in the new order of things, and most of the officials passed over into the service of the Prussian rulers, but the nobility, Lutheran clergy, &c., were less easily reconciled, or remained irreconcilable, and the present Duke of Cumberland still claims to be the rightful king. Hanover, however, has been more and more closely incorporated with the rest of the Prussian dominions, special laws having been passed with that object in view, one in particular putting an end to the preponderance of the land-owners in the provincial diet. The province sends 86 members to the Prussian chamber of deputies and 10 to the House of Lords (Herrenhaus). The highest court of the province is at Celle.

History.—The countries of which the Kingdom of Hanover is now composed were, in early times, the theatre of protracted contests between the Saxons and the Romans. The north parts were inhabited by Chauci; the centre by Longobardi, Chamavi, Sicambri, Cherusci, &c., and the south by Chatti, who, at a later period, advanced as far as the Aller. After the Romans lost their footing in the country, and the Longobardi were expelled from it, the Saxons became sole possessors, and divided it into three principal parts—Ostphalen, Engern, and Westphalen. The first great steps in civilization were taken by Charlemagne; who, having subdued the Saxons, introduced Christianity, and founded several bishoprics. Wittekind, the Saxon leader, by becoming a Christian, lost much of his influence with the great

body of his countrymen, who still continued pagans, but was allowed to possess his hereditary states. Charlemagne placed the newly-conquered territory under the government of Count Egbert, whose descendants remained in the possession of certain lands here, with the title of Dukes of Saxony, till about the middle of the tenth century the emperor Otto bestowed it as a fief upon Hermann Billing, who already possessed considerable estates about the same quarter, and who now became the most powerful prince in what is now called Hanover. The dynasty of Hermann became extinct with Magnus in 1106, when the Duchy of Saxony passed to Lothaire, afterwards emperor, and the hereditary estates of the house of Billing passed to the house of Guelf by the marriage of the eldest daughter of Magnus to Henry the Black, duke of Bavaria, who subsequently greatly extended his possessions by the addition of the principalities of Brunswick, Göttingen, &c. His son, Henry the Proud, inherited all his dominions, and also acquired the Duchy of Saxony by his marriage with Gertrude, the daughter of the emperor Lothaire. Their son, Henry the Lion, made many new conquests; and became so powerful as to excite the jealousy of the emperor, who placed him under the ban of the empire, and succeeded in stripping him of the greater part of his dominions. On his death shortly after, in 1195, the possessions left to him were shared by his three sons, the issue of his marriage with a daughter of Henry II. of England. William, the third of the sons, was the only one who had male heirs. Through them the lines of Brunswick-Wolfenbüttel and of Brunswick-Lüneburg were ultimately formed. Ernest Augustus, one of the princes of the latter branch, after making several important additions to his territories, was raised to the dignity of Elector of Hanover in 1692, and married the daughter of the Elector Palatine, granddaughter of James I., and niece of Charles I. of England. He was succeeded in 1698 by his son, George Louis, who, in accordance with the Revolution settlement of 1688, became sovereign of England, under the name of George I., on the demise of Queen Anne, in 1714. The connection thus formed with the crown of England continued during four succeeding reigns, in which considerable additions of territory were made. In 1814 the Congress of Vienna raised Hanover to the rank of a kingdom. Two independent crowns were thus worn both by George IV. and William IV.; but on the accession of her majesty Victoria to the crown of England the Salic law placed the other crown on the head of the nearest male heir, Ernest Augustus, duke of Cumberland. His reign passed peacefully, while nearly all the other states of Germany were fearfully convulsed. He died in November, 1851, and was succeeded by his son, George V. In 1866, however, Hanover became involved in the Austro-Prussian contest, and sided with Austria; the capital was occupied by Prussian troops; the king lost his throne, his estates were sequestrated, and Hanover was absorbed into the dominions of Prussia.

HANOVER, a town in Prussia, capital of the province of the same name, in an extensive plain northeast of a height called Mount Linden, at the confluence of the Ihme with the Leine, 44 miles W. by N. of Brunswick. It consists of an old town, intersected by the Leine, and of various modern suburbs surrounding the old town, the greater part of the city being on the east of the Leine. The old town is altogether unattractive, but the new quarters are regular and well built, and the town as a whole is considered one of the most attractive in Germany. The principal buildings and objects deserving of notice are the Markt (market) church, of very antique appearance; the Kreuz (cross) church; Schloss (palace) church, a handsome structure, with an altar-piece by Lucas Cranach, and some curious relics collected by Henry the Lion; several handsome churches of recent erection; the royal palace (1636–40, rebuilt since 1817), large and of considerable architectural merit, now a royal Prussian residence; the former palace of King Ernest Augustus (in government occupancy); the royal library; the theatre, a striking modern building; the central railway-station, one of the largest and finest in Germany; the museum of art and science; the old town-house (1489–55, latterly re-built and enlarged); the new town-house (formerly palace of George V.); the Kestner museum of antiquities; the provincial assembly house; the Franco-German war monument; the Waterloo Monument; various schools, among which is the technical high-school, a remodelled building of great extent, formerly the Welfenschloss (palace of the Guelfs), and the Schloss-Herrenhausen, formerly a royal residence. Trade and industries are important, the latter embracing railway works, machinery, iron castings, cotton, linen, tobacco, lacquered wares, lamps, glass, chemicals, &c.; breweries and distilleries. The city has electric tramways.

Hanover is first mentioned in 1163. It joined the Hanseatic League in 1481, and received the Reformation in 1533. It became the residence of the dukes of Brunswick-Lüneberg, and the capital of the principality in 1636; but in 1714, when the elector George became king of England, it ceased to be a royal residence, till 1837, when William IV. of England was succeeded by Ernest Augustus. In 1866 the kingdom was absorbed by Prussia, and since 1890 the city has held the position of a royal residence and capital. Sir William Herschel, the two Schlegels, and Iffland were born here. Pop. in 1895, 209,535; in 1900, 234,986.

HANSA, or HANSEATIC LEAGUE. In the middle of the thirteenth century the sea and land swarmed with pirates and robbers. The German trade, during this reign of violence, became exposed to various accidents, when the merchants lost the right of travelling with armed attendants, and the convoy afforded by government degenerated into a means of extorting a tax without yielding any protection. These circumstances gave rise to confederacies between several trading towns for mutual protection, and the furtherance of their common interests. The first alliances of this nature that are known to have been concluded are those between Hamburg and Lübeck (1241 and 1255) to keep open the road across Holstein connecting the North Sea with the Baltic, and between Lübeck, Rostock, and Weimar in 1259 for defending themselves against the pirates. About the same time a similar league was concluded between the Westphalian towns, Münster, Dortmund, Soest, and Lippstadt. When in course of time a wider union came to be formed for like purposes, the name of Hansa, an old Gothic word (used in Ulfilas' translation of the Bible) signifying a league, which was at first applied to any such confederacy, survived exclusively as the name of that influential league. During its most flourishing period it embraced ninety towns, maritime and inland, scattered over the whole length and breadth of Germany (including Holland), from Reval and Narva to Amsterdam and Middelburg, and from Cologne to Breslau and Cracow. The organization of the confederacy was a very loose one. The towns of which it was made up were at first divided into three, after the sixteenth century into four provinces, each with a chief town. One of these was formed by the so-called Wendish or Vandalic towns (Wismar, Rostock, Stralsund, &c.), with Lübeck at their head; another by the towns of Westphalia, with Cologne at their head; another by those

of Lower Saxony, with Brunswick at their head; and the last by the towns of Prussia and Livonia, with Danzig at their head. These divisions had, however, little more than a geographical significance. The town of Lübeck, which already held an important rank, from the fact that it was the highest court of appeal for all those towns which were governed by the Lübeck law, was recognized as the chief town of the league. Here assembled the deputies of the other Hanse towns to deliberate on the affairs of the confederacy; but the deputies were usually limited in the discharge of their duties by strict instructions from the towns which deputed them, and the decrees of the diet had no effect unless they received the sanction of the separate towns. The chief trading centres of the league were the factories of Novgorod in Russia, Bergen in Norway, Bruges, and London (the so-called Steelyard), besides the peninsula between Skanör and Falsterbode, in the south-west corner of Sweden, which, from the thirteenth to the sixteenth century, was the centre of a very productive herring fishery.

In the fourteenth century the league everywhere attained a high political importance, and gave rise to the development of that commercial policy which has since become intimately connected with all political relations, but of which the sovereigns of that time had little idea. The object of the league was now more fully declared: to protect themselves and their commerce from pillage; to guard and extend the foreign commerce of the allied cities, and, as far as practicable, to monopolize it; to manage the administration of justice within the limits of the confederacy; to prevent injustice by public assemblies, diets, and courts of arbitration; and to maintain the rights and immunities received from princes, and, if possible, to increase and extend them. Among the internal regulations were the obligations incurred on being received into the confederacy, to furnish soldiers and vessels, or, in certain cases, money as a substitute, and to pay the duties and amercements. The league exercised a judicial power, and inflicted the greater and lesser ban. Any place which incurred these punishments was said to be *verhansed*. Foreign factories were subject to an almost monastic discipline, which even required the celibacy of factors, masters, and members of the guilds. By a uniform adherence to their great object, and by the maintenance of good order, the Hanseatic cities obtained a great importance, although the confederacy was never formally acknowledged by the empire; and kings and princes were, in reality, more dependent on the league than it was on them. The Hanse towns in England were exempted from duties on exports, and in Denmark, Sweden, and Russia from those on imports—privileges which were enjoyed by no subjects of those countries.

The extensive carrying trade of the Hanseatic confederacy was a great source of wealth; and, at length, there was no mart in Europe which was not gradually drawn within the circle of its influence; and by the greatness of its wealth and the might of its arms it became the mistress of crowns, and lands, and seas. It conquered Eric and Hakon, kings of Norway, and Waldemar III. of Denmark. It deposed a king of Sweden, and gave his crown to Albert, duke of Mecklenburg, who rewarded them with the grand privilege of 1368. England, Denmark, and Flanders concluded treaties with the league for the extension of their commerce. It undertook to provide for the security of commerce on the Baltic and North seas. In the country under its immediate influence it constructed canals, and introduced a uniform system of weights and measures.

But the prosperity of the Hanse towns was naturally dependent on the continuance of the circumstances which gave rise to it; and when those circumstances changed, the league was destined to fall. When, therefore, the routes by land and sea were no longer insecure; when princes learned the advantages of trade to their own states, and turned their attention to the formation of a naval force of their own, and the encouragement of navigation; when the inland members of the confederation perceived that the great sea-port towns had a separate interest of their own, and used them principally to promote their own ends; then the dissolution of the Hanseatic League was evidently approaching. There remained at last, as active members of the Hansa, only Hamburg, Lüneburg, Lübeck, and the towns in the neighbourhood (Wismar, Rostock, Greifswald, Stralsund), whose interests were identified with those of Lübeck. It was these towns almost alone that, during the fifteenth and sixteenth centuries, fought the battles of the league, and in the wars against the kings of the united Scandinavian dominions maintained for the league the command of the Baltic. The last and most brilliant success of the Hansa was the dethronement of Christian II., and the final dissolution of the Scandinavian union in 1523 by an alliance between Lübeck and Danzig. Very soon after this the command of the Baltic was lost by the maritime cities, and the Dutch, who had for about a century been shut out of the Baltic trade, had again to be allowed to take part in it. The league existed no longer as a political power, but merely as a loose association of towns for commercial purposes. The Scandinavian kingdoms began to develop an independent industrial and commercial activity, and thus the so-called Wendish towns lost their chief market. The herring trade of the peninsula of Skanör declined, from the fact that about the middle of the sixteenth century the shoals deserted the Baltic for the North Sea. The Russian trade had already in 1494 received a rude shock by the destruction of the Hanseatic factory at Novgorod by Ivan Vassilievich, and again suffered greatly during the contests between Russia, Sweden, and Poland for the possession of Livonia. The Dutch competition became always keener, and it was of no benefit to the league that it, in 1546, removed its factory from the declining town of Bruges to Antwerp, then rising in commercial importance. In England, during the reign of Queen Elizabeth, the league lost its privileges by its refusal to grant complete reciprocity. About 1614 there remained only fourteen towns which contributed to the support of the league, and had a voice in the management of its affairs. These were—Lübeck, Wismar, Rostock, Stralsund, Greifswald, Stettin, Danzig, Magdeburg, Brunswick, Hildesheim, Lüneburg, Hamburg, Bremen, and Cologne. The Thirty Years' war, which destroyed the prosperity of the German towns generally, gave the death-blow to the Hansa. At the diet of 1629 it was intrusted to the cities of Lübeck, Bremen, and Hamburg to consult for the general interests of the league, and in 1630 these towns concluded among themselves a closer union, which was renewed in 1641. After the Peace of Westphalia (1648) repeated attempts were made to bring the league together again, and a last diet was held in 1669, at which there were representatives from Lübeck, Bremen, Hamburg, Brunswick, Danzig, and Cologne. This diet, however, led to no results, and it was the last common act of the expiring confederacy. The name still remained attached to the free cities of Lübeck, Bremen, and Hamburg, under whose protection the surviving factories of the league still continued to exist, that of Bergen being still managed in the old way till 1763. In 1813 Frankfort-on-the-Main was included in the number, and in the Old German Confederation four cities had together one

vote in the diet. In 1853 the Steelyard at London was sold, and finally in 1858 the Osterling house at Antwerp, the last common possession of the ancient league. In 1866 Frankfort-on-the-Main was incorporated with Prussia, but the other three towns still retain their independence, and now form separate constituents of the German Empire.

HANSARD, a firm of printers in London, well-known as the printers of the debates in Parliament. The first of the family who came to London was Luke Hansard, born at Norwich in 1752, who became a partner in the house of Hughs, the parliamentary printer, in 1774, and in 1800 succeeded to the business, which was continued down to quite recent times and was latterly converted into a limited company. The Hansards were not the only printers who did parliamentary work, including bills before Parliament, reports of committees, &c.; but as already stated, they owed their celebrity to the reports of the debates in both houses of Parliament. These reports were extracted from the morning journals, but were not printed in Hansard's collection until they had been revised and, where necessary, corrected or even amplified by the speakers, so that Hansard is looked upon as an unquestionable authority for the opinions which any member of either house expressed or endeavoured to express. The name is still given to the reports now otherwise furnished.

HANUMAN, in Indian mythology, a personage who plays a prominent part in the epic Râmâyana, especially in connection with the war of Râma (the seventh incarnation of Vishnu) against the giant Râvana. He is represented as the son of Vâyu, the god of the wind, by an apsaras or nymph called Punjikasthalâ, who was born under a curse as the daughter of a monkey, but who had the power of assuming what form she pleased. The name Hanumân signifies 'having a jaw,' but it is interpreted as signifying 'with a broken jaw,' and the hero is said to have got the name in childhood when he darted up from his cradle to seize the sun, which he took to be a fruit, and was cast down for his presumption by the thunderbolts of Indra, and alighting on a mountain broke his left jaw. Hanumân, like his mother, had naturally the form of a monkey, and this form he does not appear to have been able to change, although he could assume any size he liked, from that of a mountain to that of a man's thumb. He was the general of the monkey-king Sugûva, the ally of Râma. When Râma lost his wife Sîta Hanumân was sent out as the commander of an army of monkeys to bring tidings of her, and after crossing the strait separating the mainland of India from the island of Ceylon (which he did by a single bound), found her in Lanka in a grove of asokas attached to King Râvana's palace. Upon his demand for her restoration being refused by Râvana, Hanumân returned to Râma and informed him of the place where his wife was concealed. An army was then equipped, and war was waged against Râvana, and in this war Hanumân performed signal services not only by his strength and valour in battle, but also by bringing medicinal herbs from the Himalayas to heal the wounded and raise the dead among his allies. This he did upon two occasions, on both of which, finding some difficulty in discovering the plants of which he was in search, he carried off the whole mountain on which they grew. After Râvana was slain and Sîta recovered Hanumân was sent to announce the return of Râma to his own kingdom. Hanumân is regarded in India as a demigod, on which account the whole tribe of monkeys to which he belonged is treated as sacred and allowed to multiply indefinitely.

The myth of Hanumân is supposed to have had a historical origin, Hanumân being the ally of a Brahmanical prince who introduced Brahmanic institutions into Ceylon, and called a monkey-chief on account of the barbarous condition of his followers. Other elements in the stories related of him point to a physical origin. See MYTHOLOGY.

HANWAY, JONAS, a traveller and philanthropist, born at Portsmouth in 1712. At an early age he was apprenticed to a merchant at Lisbon, and in 1743 became a partner in a British house at St. Petersburg. The concerns of the partnership rendered a journey to Persia desirable, and it was gladly undertaken by Hanway, who went to Astrabad with a cargo of British goods. In 1753 he published a work entitled An Historical Account of the British Trade over the Caspian Sea, &c., with the Particular History of the great Usurper Nadir Kouli (four vols. 4to). In the same year he engaged in the controversy concerning the naturalization of the Jews, and published a Review of the Proposed Naturalization, by a Merchant, a third edition of which appeared the same year. From this time he continued publishing, on a variety of topics, all relating to points of public good or schemes of charity and utility. His fellow-citizens entertained such a sense of his merits, that a deputation of the principal merchants of London waited upon Lord Bute, to request that some public mark of favour might be conferred upon a man who had done so much service to the community, at the expense of his private fortune. He was, in consequence, made a commissioner of the navy, which post he held for twenty years, and on resignation was allowed to retain the salary for life. He died in 1786, and a monument was erected to him by subscription.

HAPSBURG (properly *Habsburg*), a small place in the Swiss canton of Aargau, on the right bank of the Aar. The castle was built in the eleventh century by Bishop Werner, said by genealogists to have descended from Ethico I., a count of Alemannia, in the seventh century, on a steep rocky situation, whence the name, which was originally *Habichtsburg* (Hawk's-Castle). The proprietors of Hapsburg became at a later period counts of Hapsburg, and gradually acquired a more extensive territory. Werner II., who died in 1096, is said to have been the first to assume the title. After the death, about 1232, of Rudolph II., the fourth in succession from Werner II., the family divided into two branches, the founder of one of which was Albert IV., and that of the other Rudolph III. The latter is known as the Hapsburg-Lauffenburg line, which became extinct in the direct male line in 1408. A younger son of Rudolph, called Eberhard, founded the Kyburg branch of the Hapsburg-Lauffenburg line, which did not become extinct till 1415, and Godfrey, a grandson of Rudolph, who settled in England in the thirteenth century, there became the founder of the Fielding family, to which the Earls of Denbigh belong, and of which the novelist Fielding was a member. The line descended from Albert IV. is that to which the historical celebrity of the house is almost entirely due. In 1273 Rudolph, the son of Albert IV., was chosen Emperor of Germany. He is the founder of the reigning house of Austria, which is of the line of Hapsburg-Lorraine. From Rudolph to Charles VI. the Austrian monarchs were of the Hapsburg male line. Maria Theresa, who succeeded Charles VI., married Francis Stephen of Lorraine, who in 1745 was chosen Emperor of Germany. Francis II., the third emperor of Germany of the line of Hapsburg-Lorraine, was the last who bore that title till the establishment of the new empire, the last of the so-called 'Holy Roman Emperors.' He changed it in 1806 for that of Emperor of Austria, and the present imperial house of Austria continues to represent that line.

From the Emperor Rudolph was also descended a Spanish dynasty which began with the Emperor Charles V. (Charles I. of Spain), and terminated with Charles II. in 1700. The castle of Hapsburg is still to be seen on the Wülpelsberg.

HARAKIRI, or SEPPUKU, a mode of inflicting death upon themselves allowed in Japan to criminals of the Samurai or two-sworded class as more honourable than public execution. It consisted in cutting open the body so as to disembowel it, by means of a wound made with one sword perpendicularly down the front and another with the other sword horizontally. It was regarded as honourable in criminals of high rank to kill themselves thus.

HARBIN, a town of Manchuria, in the province of Kirin, about 330 miles north-east of Mukden. It stands near the right bank of the Sungari, a tributary of the Amur, close to the Mongolian frontier, and is the place where the Siberian Railway forks, sending one branch to Mukden and Port Arthur and another to Vladivostok. Pop. 10,000.

HARBOUR, a general name given to any bay, creek, or inlet of the sea affording accommodation for ships and protection against the wind and sea. They are either natural or made wholly or partly by the construction of piers, moles, breakwaters, or other works. In connection with the more important harbours there are usually docks. See BREAKWATER and DOCKS.

HARBURG, a town and port of Prussia, in the province of Hanover, and in the district of Lüneburg, on the South Elbe, opposite to Hamburg. It has a castle formerly serving as a citadel, extensive manufactures of articles in india-rubber, large palm-oil works, chemical works, machine works, ship-yards, works for spinning and weaving jute, artificial manure works, breweries, &c., and an important transit trade, greatly favoured by its vicinity to Hamburg and its situation on the Hanover and Hamburg Railway. The independent trade has also greatly increased in recent years. The marine shipping has considerably declined of late, owing to the improved and extended harbour accommodation of its great rival Hamburg. The river shipping, on the other hand, has become much more active than formerly. Pop. (1895), 42,579; (1900), 49,153.

HARDENBERG, FRIEDRICH VON, known as an author under the name of *Novalis*, born May 2, 1772; died March 25, 1801. His parents paid great attention to his education. In Jena Von Hardenberg studied philosophy, and at Leipzig and Wittenberg the law. From thence he went to Tennstädt, where it was intended he should be practically instructed in jurisprudence. In December 1797 he went to Freyberg, where Julia von Charpentier won his affections. In 1799 he formed a friendship with L. Tieck and the two Schlegels. He had made himself well acquainted with law, natural philosophy, mathematics and philosophy, but was most eminent for his poetical talents. In the works of Novalis there is a singular mixture of imagination, sensibility, religion, and mysticism. He was the gentlest and most amiable of enthusiasts. Some of his hymns are very beautiful. His novel Heinrich von Ofterdingen was left unfinished. His Hymns to Night have the greatest merit. His works have been repeatedly published. See Carlyle's Miscellaneous Essays.

HARDENBERG, KARL AUGUST, BARON, afterwards PRINCE OF, Prussian chancellor of state. He was born at Essenrode in Hanover, May 31, 1750, and after having completed his studies in Leipzig and Göttingen, entered the civil service of his country in 1770. He passed several years in travelling through Germany, France, Holland, and particularly England. In 1778 he was made privy-councillor; but a misunderstanding with one of the English princes induced him to resign his place in 1782, and to enter the service of Brunswick. The duke sent him to Berlin in 1786 with the will of Frederick II., which had been deposited with him. Here he gave so much satisfaction that the duke sent him repeatedly to the same place. In 1790 he was made minister of the last margrave of Anspach and Baireuth, on the recommendation of Prussia. When the margravate was incorporated with Prussia, Hardenberg remained in his office, and was made Prussian minister of state, and soon after cabinet minister. April 5, 1795, he signed the peace between the French Republic and Prussia, on the part of the latter. In 1804 he succeeded Haugwitz as first minister of state in Prussia, and favoured a hostile policy with reference to France. The disasters which Prussia soon after suffered in the conflict with Napoleon are well known. In consequence of the treaty of December 15, 1805, which Haugwitz concluded at Vienna between Prussia and France, Hardenberg again gave up his place to that minister; but on the breaking out of the war of 1806 he once more resumed the portfolio. After the Peace of Tilsit he asked for his dismission; but in 1810 the King of Prussia appointed him chancellor of state (prime minister), and endeavoured to form a union with France; but the disasters of the French army in Russia changed his policy. Hardenberg signed the Peace of Paris, and was created prince. He went to London with the sovereigns, and was one of the most prominent actors at the Congress of Vienna. He was subsequently the active agent in all matters in which Prussia took part; he was made president of the council of state; was present in 1818 at the Congress of Aix-la-Chapelle; in 1819 at Carlsbad; in 1820 at Troppau; in 1820–21 at Laybach; and in 1822 at Verona. In the same year he signed the concordat between Prussia and the pope. While on a journey in the north of Italy he fell sick at Pavia, and died at Genoa, November, 1822. As to his political principles in the latter part of his life, he was an active minister of the holy alliance; but still he understood that the time of feudalism was past, and his abolition of feudal services and privileges in Prussia will always be remembered in his favour. He patronized the sciences munificently, and the foundation of the University of Bonn is honourable to him. He loved power, but at the same time his administration had many good features. His Memoirs from 1805 to the Peace of Tilsit were published by Ranke in 1877 (Leipzig, five vols.), under the title Denkwürdigkeiten des Staatskanzlers Fürsten von Hardenberg, with a biography. See also Meier's Die Reform der Verwaltungsorganisation unter Stein und Hardenberg (1881).

HARDERWIJK, a town in Holland, in the province of Gelderland, on the Zuider Zee, 30 miles east of Amsterdam, surrounded by pleasure-gardens, arable and meadow land. It is fortified towards the land, has several gates, and two large market-places, in one of which is the town-hall and the weigh-house; in the other is held the fish and the cattle market, and being planted with trees, it likewise forms a promenade. Its harbour is suitable only for fishing-vessels. Seafaring, fishing, and herring-smoking are the principal occupations. It was taken by Charles V. in 1522, and by the French in 1672. A university was founded here in 1648, but was suppressed in 1811. Pop. (1899), 7327.

HARDICANUTE, or HARTHACNUT, King of England and Denmark, was the only legitimate son of Canute, by Emma, daughter of Richard, duke of Normandy. At the time of his father's death in 1036 he was in Denmark, where he was immediately recognized as king. His half-brother Harold, how-

ever, who happened to be in England at the time, laid claim to the throne of that part of their father's dominions. For a time the mother of Hardicanute succeeded in holding Wessex in his name, while Mercia and Northumbria were held by Harold, such an allotment having been made by a witenagemote held at Oxford. Hardicanute, although of a sluggish and indolent temper, and naturally disinclined to take active measures to enforce what he believed to be his just claims, was not altogether satisfied with this settlement; and when Emma was ultimately forced to leave England and take refuge in Bruges, he was induced by her exhortations to collect an army for a descent upon England. Just at this juncture Harold died (1040), when Hardicanute peacefully succeeded him. He reigned till 1042, but his reign was not marked by any important event. He left the government almost entirely in the hands of his mother and the powerful Earl Godwin, while he gave himself up to feasts and carousals. He died after a debauch in celebration of the marriage of one of his thanes.

HARDINGE, Henry, first Lord, third son of the Rev. Henry Hardinge, rector of Stanhope, in Durham, was born at Wrotham in Kent in 1785, and had so early selected the military profession that he was gazetted as ensign before he had completed his fifteenth year. He served during the whole of the Peninsular war. During the embarkation after the battle of Corunna his courage and activity attracted the attention and gained him the patronage of Marshal Beresford. Under his auspices he obtained a brigade in the Portuguese service before he was twenty-five, and ere long had the same rank in the British army. The first battle in which he particularly signalized himself was that of Albuera, in 1811, where a celebrated charge ordered by him on his own responsibility, or at least suggested by him (for there is some dispute on the point), carried the day, and made that a victory which had at one time threatened to be a defeat. He was present at all the great battles and sieges in the Peninsula, and accompanied Wellington when, after he had driven the French out of Spain, he carried the war into their own territory. The sudden return of Bonaparte from Elba having obliged the allies again to muster their forces, Hardinge was attached as British commissioner to the Prussian army, and lost his left hand by a cannon-shot at the battle of Ligny. This wound made it impossible for him to take any part in the crowning victory at Waterloo. In the early part of 1815 he was rewarded for his services with the rank of Knight Commander of the Bath. In 1820 he was returned to Parliament as member for Durham. In the Wellington ministry he was secretary-at-war. This office he exchanged in 1830 for that of secretary of Ireland. He held the same office again in 1834–35, and from 1841 to 1844 under Sir Robert Peel. In 1844 he was appointed to succeed Lord Ellenborough as Governor-general of India. Here, after introducing many useful reforms, and endeavouring to pursue a peaceful course, he was forced into war by a most unwarrantable invasion of the British territory by the Sikhs. Though taken somewhat by surprise by this barbarous irruption, he showed no want of energy after the sword had been drawn, and volunteering to act under the commander-in-chief, took a personal share in the great battles of Mudki, Ferozeshah, and Sobraon (1845–46), the last of which laid the Sikhs at his mercy, and enabled him to dictate a humiliating peace to them in their capital of Lahore. In reward of his services he was created Viscount Hardinge, and received two pensions, one of £5000 voted by the East India Company, and the other of £3000 voted by Parliament, to himself and his next two successors. Having resigned the office of governor-general, which he had held for only four years, he returned home in 1847, and on the death of the Duke of Wellington in 1852 succeeded him as commander-in-chief. This high office he held during the Russian war, and did not escape the criticisms which have been freely applied to all who were then in authority for mismanagement, which, long suspected, at last became only too palpable. In Oct. 1855 he was made a field-marshal. His death took place at his seat of South Park, near Tunbridge Wells, on 24th September, 1856, at the age of seventy-one.

HARDNESS, the quality of bodies which enables them to resist abrasion of their surfaces. It depends on the cohesive forces with which the minute particles of the body are joined together. The hardness of bodies is compared by observing which of two scratches the other when they are rubbed together; sometimes a scale is used in which a set of standard bodies is arranged and numbered, and other bodies are referred to this scale with respect to hardness. The following is the table of Mohs:—

Talc,.....1	Felspar,.....6
Rock-salt,.....2	Rock-crystal,.....7
Calcareous spar,....3	Topaz,.....8
Fluor spar,.....4	Corundum,.....9
Apatite,.....5	Diamond,.....10

Materials, according to this arrangement, which are scratched by rock-crystal and are not scratched by felspar are said to have a hardness between 6 and 7. The hardness of bodies is difficult to determine, and is not found to be very constant except in the case of crystals of definite constitution.

HARDOUIN, John, a learned French Jesuit, no less celebrated for his intimate acquaintance with the classical authors of antiquity, than remarkable for the singularity of his opinions respecting the authenticity of their writings. He was born in 1646 at Quimper in Bretagne, and died at Paris, 1729. The work by which he is principally known is his Chronologiæ ex Nummis antiquis restitutæ; Prolusio de Nummis Herodiadum, in which he supports the extraordinary hypothesis that all the writings under the names of the Greek and Roman poets and historians, except those of Homer, Herodotus, Cicero, and Pliny the Elder, the satires and epistles of Horace, and the Georgics of Virgil, are the spurious productions of the thirteenth century, written by monks under the direction of one Severus Archontius. He contends at the same time that the other works attributed to Horace and Virgil are allegorical, and, under the names of Lalage and Æneas, represent the Christian religion and the life of its founder. This treatise was condemned and proscribed, the author was called upon for a public recantation of his errors, which in fact he made; but he afterwards repeated his offence in other publications. Among his 102 works are Nummi antiqui Populorum et Urbium illustrati (1684); Pliny's Natural History, in usum Delphini (five vols. 4to, 1685); and Collectio Conciliorum in twelve folio volumes (1715). On this latter work he expended a great deal of time and labour, but it was suppressed by the Parliament. He considered all the councils previous to that of Trent as imaginary. A selection from Father Hardouin's works, comprising most of those which had fallen under the censure of the Romish Church, appeared in 1709 at Amsterdam. Another selection was published with the title Opera Varia, in 1733.

HARDWARE, the name usually given to the commoner articles made of iron, brass, and copper. The manufacture of such articles now forms a gigantic industry in Great Britain, especially in England. The value of the articles of this class (including

cutlery) exported to all parts in 1899 was £2,139,492, but this represents but a small fraction of the total amount manufactured. The chief seats of this industry in England are Birmingham and the neighbouring towns, and for cutlery Sheffield.

HARD-WOODED TREES are usually trees of slow growth, such as the oak, beech, witch-elm, elm, ash, service-tree, walnut, chestnut, acacia, &c. They are distinguished from soft-wooded trees such as the willow, poplar, &c., and resinous trees such as the pine, fir, cedar, larch, &c.

HARE (*Lepus*). The generic characters of this well-known animal are, four cutting teeth in the upper jaw, and two in the lower; two of the upper teeth, however, are placed behind the others, and are of a much smaller size; the whole dental formula is, incisors $\frac{4}{2}$, canines $\frac{0}{0}$, molars $\frac{6}{6}\frac{6}{6} = 28$; the two fore-feet with five, and the hinder with four toes. These animals are found in almost every part of the world, living entirely on vegetable food, and all remarkably timid. They run by a kind of leaping pace, and, in walking, use their hind feet as far as the heel. Their tails are either very short or almost wanting. The female goes with young about a month, generally producing three to six at a litter, and this about four times a year. The eyes of the young leveret are open at birth. The dam suckles them about twenty days, after which they leave her, and procure their own food.

The European hare (*L. timidus*) is found throughout Europe and some parts of Asia. The colour of this species is of a tawny red on the back and sides, and white on the belly. The ears, which are very long, are tipped with black; the eyes are very large and prominent. The length of this animal is about 2 feet, and when full grown it weighs 6 to 8 lbs. It is a watchful, timid creature, always lean, and from the form of its legs, runs swifter up hill than on level ground. Hares feed on vegetables, and are very fond of the bark of young trees; their favourite food, however, is parsley. Their flesh was forbidden to be eaten among the Jews and the ancient Britons, whilst the Romans, on the contrary, held it in great esteem. 'Inter quadrupedes gloria prima lepus,'—Martial; and Horace, who is good authority as an epicure, says, Every man of taste must prefer the fore shoulder—'Fecundi leporis sapiens sectabitur armos.' The flesh is now much prized for its peculiar flavour, though it is somewhat dry, and devoid of fat. The voice of the hare is never heard but when it is seized or wounded. At such times it utters a sharp, loud cry, not very unlike that of a child. It has a remarkable instinct in escaping from its enemies; and many instances of the surprising sagacity of these animals are on record, though it appears that all of them do not possess equal experience and cunning. A perpetual war is carried on against them by cats, wolves, and birds of prey; and even man makes use of every artifice to entrap these defenceless and timid creatures. They are easily tamed, but never attain such a degree of attachment as renders them domestic, always availing themselves of the first opportunity to escape. Among the devices of hares to elude their pursuers the following have been observed: Getting up into a hollow tree, or upon ruined walls; throwing themselves into a river and floating down some distance; or swimming out into a lake, keeping only their nose above the surface; returning on their own scent, &c. As might be expected varieties occur in different parts of the wide area the hare occupies. Blasius groups them under three races. The north-eastern with thick fur, whitening in winter; the central with moderate fur, gray in winter; and the southern with thin fur, and dominant reddish tinge. (See the illustration at RODENTIA.) The mountain or blue hare (*L. variabilis*), with its shorter black-tipped ears and notched upper grinder, is confined to Northern Europe and the mountainous regions of the South. It is less swift than the common hare, changes colour seasonally, and has only two broods in the year. *Lepus cuniculus* is the rabbit.

The hare of America (*L. Americanus*), there known under the name of *rabbit*, is found in most parts of North America. The summer hair is dark brown on the upper part of the head, lighter on the sides, and of an ash colour below; the ears are wide, edged with white, tipped with brown, and dark coloured on their back; tail, dark above, white beneath, having the inferior surface turned up; the fore-legs are shorter and the hinder longer in proportion than those of the European. In the Middle and Southern States the change in the colour of the hair is by no means as remarkable as it is farther north, where it becomes white, or nearly so. This species is from 14 to 18 inches long. The American hare generally keeps within its form during the day, feeding early in the morning or at night. The flesh is dark coloured, but is much esteemed as an article of food. It is in its prime late in the autumn and in the winter. It is not hunted in America as in Europe, but is generally roused by a dog and shot or caught by means of snares or a common box trap: this latter is the most usual mode. In its gait it is very similar to the European, leaping rather than running. Like that animal it breeds several times during the year. There are several other species of the hare inhabiting North America, of which the most remarkable is the polar hare (*L. glacialis*). This occurs in vast numbers towards the extreme northern part of the continent. It is larger than the common hare. The fur is exceedingly thick and woolly, of the purest white in the cold months, with the exception of a tuft of long black hair at the tip of the ears. In summer the hair becomes of a grayish brown. See RABBIT.

SUPPLEMENT.

FRANCIS JOSEPH I., Emperor of Austria and King of Hungary and Bohemia, was born on Aug. 18, 1830, and succeeded his uncle, Ferdinand, who abdicated in 1849. The chief events of his reign have been the cession of Lombardy to Italy, as a result of the war with France and Italy (1859); and the loss of Venetia, as also of Austria's important influence in Germany, the result of the war with Prussia (1866). In the earlier portion of his reign he pursued an autocratic policy and vigorously repressed all aspiration towards independence on the part of races subject to him, but since 1860 he has somewhat liberalized his government. His only son, Rudolf, committed suicide in 1889, and the emperor's nephew, the Archduke Francis Ferdinand, is heir-presumptive. See the article AUSTRIA.

FRANKLAND, SIR EDWARD, chemist and authority on sanitation, was born near Lancaster on Jan. 18, 1825. He received his earlier education at the Lancaster Grammar School, and afterwards studied at the Royal School of Mines, London, and at the Universities of Marburg and Giessen, Germany. He was appointed Professor of Chemistry in Owens College, Manchester, in 1851, and held that post till his appointment in 1857 to a similar position in the medical school attached to St. Bartholomew's Hospital, London. From 1863 till 1867 he occupied the chair of chemistry in the Royal Institution, and from 1865 till his retirement in 1885 he was professor at the Royal School of Mines (now merged in the Royal College of Science). He was elected a Fellow of the Royal Society in 1853, and was also connected with the Vienna Academy of Sciences, the French Academy of Sciences, and other foreign learned bodies. He served on the Royal Commission appointed in 1868 to institute an inquiry into the pollution of rivers and domestic water-supply, and in 1871 he was appointed President of the Chemical Society. He held various honorary degrees, and in 1897 he was created a Knight Commander of the Bath. For many years he furnished monthly reports to the Local Government Board on the water-supply of London. His published works include Experimental Researches in Pure, Applied, and Physical Chemistry (1878), a collected edition of his chemical papers; Water Analysis for Sanitary Purposes (1880); some manuals for students; &c. He was joint-author with Norman Lockyer of Researches connected with the Atmosphere of the Sun. He died in Norway on Aug. 9, 1899.

FRANKLAND, PERCY FARADAY, chemist and authority on micro-chemical questions, the second son of above, was born on Oct. 3, 1858. He was educated at University College School, London, and the Royal School of Mines, afterwards prosecuting his chemical studies at Würzburg University, where he graduated Ph.D. with honours in 1880. In that year he became demonstrator and lecturer on chemistry at the School of Mines, in 1888 professor of chemistry in University College, Dundee. In 1894 he was appointed professor of chemistry in Mason College, Birmingham, now the University of Birmingham. His published works, which deal mostly with micro-chemistry, the chemistry of fermentation and bacteriology, include Agricultural Chemical Analysis (1883); Our Secret Friends and Foes (1894, on Micro-organisms); Micro-organisms in Water (1894); Life of Pasteur (1897); and many lectures and papers in the transactions of various societies. He was elected F.R.S. in 1891. In several of his works he has been assisted by his wife, a daughter of Joseph Toynbee, aural surgeon, and sister of the philanthropist Arnold Toynbee.

FRASER, ALEXANDER CAMPBELL, Scottish writer on philosophy, was born on Sept. 3, 1819, at Ardchattan in Argyllshire, where his father was parish minister. His early education was received at home, and he subsequently attended the Universities of Glasgow and Edinburgh, graduating at the latter in 1838. In 1846 he became professor of logic in New College, Edinburgh, a post which he held till he succeeded Sir William Hamilton in 1856 as professor of logic and metaphysics in the university. From this chair he retired as emeritus professor in 1891. From 1850 till 1857 he edited the North British Review. From 1894 till 1896 he was Gifford Lecturer at Edinburgh. Besides a large number of contributions to the Encyclopædia Britannica and various periodicals, he has written Essays in Philosophy (1856); Rational Philosophy (1858); Berkeley: a Biography (1881); Locke (in the Philosophical Classics series, 1890); Philosophy of Theism (his Gifford Lectures, 2 vols., 1896–97; 2nd edn. 1899). He has also edited an edition of Berkeley's works, with notes, dissertations, and life (1871; 2nd edn. 1900); Annotated Selections from Berkeley (1874; 5th edn. 1899); and an edition of Locke's Essay, with notes and dissertations (1894).

FREDRIKSTAD, a seaport and town of Norway, at the mouth of the Glommen, 48 miles S.E. of Christiania. It exports much timber, and has brick-works, shipbuilding yards, textile-mills, engine-works, &c. Its harbour is kept open in winter by an ice-breaker. Pop. in 1900, 14,635.

FREE LIBRARIES. See LIBRARIES' ACTS.

FREEMAN, EDWARD AUGUSTUS, one of the greatest of 19th-century historians, was born at Harborne, near Birmingham, in 1823. Early orphaned, he was educated at a private school at Ewell, Surrey, and at Trinity College, Oxford, where he obtained a scholarship in 1841, and a fellowship in 1845 after a not specially distinguished academical career. His marriage in 1847 vacated his fellowship, and retiring first to Monmouthshire and then to a small

estate at Somerleaze, in Somersetshire, he devoted himself to literature. His first publication (1849) was a History of Architecture, a subject in which he maintained interest throughout his life. This work was more especially devoted to Gothic architecture. His architectural researches helped to turn his attention to history, but his earliest historical works were the product of his interest in contemporary burning questions. His History and Conquests of the Saracens (1856) was partly due to the Crimean War; and the American Civil War brought forth his History of Federal Government (1863), which, however, remained a fragment in one volume. Meanwhile he had written innumerable articles in magazines, and he was one of the most valued contributors to the Saturday Review until the line taken by that paper in 1878 on the Eastern question caused him abruptly to sever the connection. Between 1867 and 1879 appeared his *magnum opus*, the History of the Norman Conquest of England, in six volumes, followed in 1882 by two supplementary volumes dealing with William Rufus and Henry I. In 1884 he was appointed regius professor of modern history at Oxford in succession to Dr. Stubbs, and this post he occupied till his death. His last great work was a History of Sicily, which he left unfinished, though three volumes of the work were published. He died 16th March, 1892, of smallpox, at Alicante, in Spain, where he was travelling for purposes of recreation and research. Other works besides those mentioned were: Old English History (1869), Growth of the English Constitution (1872), Historical Essays (three series, 1872–79), The Ottoman Power in Europe (1877), Historical Geography of Europe (two vols. 1881), Methods of Historical Study (1886), The Chief Periods of European History (1887), &c. He was a man of strong partisan feeling, with a firm belief in the superiority of the Teuton which sometimes interfered with a judicial weighing of evidence. But he took great pains to verify his facts, indeed was devoted to truth, and had a wide and deep knowledge of history. In spite of his pugnacity and the obstinacy with which he maintained his side in a controversy he was a man of generous and kindly nature. See Life and Letters by Stephens (two vols., 1895).

FREEPORT, a city of the United States, capital of Stephenson county, Illinois, 120 miles W. by N. of Chicago. It is the seat of a Presbyterian college, and has car-shops and manufactures of machinery, carpets, bicycles, vinegar, &c. Pop. (1900), 13,258.

FREIENWALDE, a town of Prussia, in the district of Potsdam and province of Brandenburg, with a chalybeate spring and bathing establishment in the vicinity. Pop. (1900), 7989.

FREMANTLE, the chief seaport of Western Australia, at the mouth of the Swan River, 12 miles from Perth, with which there is communication by rail and river steamer. The chief building in the town is the town-hall, and there is also a handsome episcopal church. The harbour accommodation is not satisfactory, but has been greatly improved. The manufactures include aërated waters, boots, soap, furniture, confectionery, &c. Pop. of town and suburbs, in 1901, 24,000.

FREMONT, an American city, capital of Sandusky county, Ohio, 30 miles east of Toledo. It has a considerable trade, lines of steamers running from the city, which stands at the head of steam navigation on the river Sandusky, to the principal ports of Lake Erie. There are manufactures of machinery, cutlery, &c. Pop. (1900), 8439.

FRENCH CONGO, a large territory on the west coast of Africa between the Lower Congo and the German Cameroons country, and stretching inland to Lake Chad; total area, about 500,000 sq. miles, of which much, especially towards the north-east, is still very imperfectly known. The chief rivers are the Muni, Gaboon, Ogowe, and Kuilu, and the stations already founded include Libreville, Brazzaville, Njola, Philippeville, Bonga, Loango, Franceville, and about twenty others. The district is under a commissioner-general, assisted by two lieutenant governors. Though it is unhealthy even in the more elevated districts for Europeans, considerable trade is carried on, the exports comprising caoutchouc, cocoa, coffee, ivory, ebony, mahogany, palm-oil, gum-copal, &c. Pop. about 5,000,000, of whom 300 are Europeans.

FRENCH SOUDAN, till 1899 the official name of a large part of the French possessions in West Africa, and still used as a convenient geographical expression. The territory of the French Soudan is partly included in the administrations of Senegal, French Guinea, and the Ivory Coast, and partly represented by the Military Territories of the interior. It extends from the upper Senegal across the bend of the Niger to Lake Chad, where it joins with the hinterland of the French Congo territory. French interference in this part of Africa began in 1860, and the regular acquisition of the region dates from 1880. The powerful chief Samory in the south was defeated and taken prisoner by the French in 1898. The occupation of Timbuctoo took place in 1894. The limits of French influence in this region have been partly defined by conventions arranged with Britain in 1890 and 1898. The chief towns are Kayes, the former capital, Bafulabé, and Bammaku, which are being connected by a railway, and Timbuctoo.

FRESHFIELD, Douglas William, traveller, was born on April 27, 1845. He was educated at Eton and at University College, Oxford, where he graduated in 1867. In 1870 he was called to the bar, but since then he has devoted himself mainly to travel in various parts of Europe, Asia, and Africa. He has visited and explored Syria, the Caucasus, Armenia, Algeria, Corsica, and the Apennines, and has published the following interesting and readable accounts of his journeys: Travels in the Central Caucasus and Bashan, including Visits to Ararat and Tabreez, and Ascents of Kazbek and Elbruz (1869); The Italian Alps: Sketches in the Mountains of Ticino, Lombardy, Trentino, and Venetia (1875); Climbs in the Caucasus (1888); Search and Travel in the Caucasus (1890); The Forests of Abkhasia (1890); and The Exploration of the Caucasus (1896). From 1872 till 1880 he edited the Alpine Journal, and in 1893–95 he was President of the Alpine Club. He was long one of the honorary secretaries of the Royal Geographical Society, and while acting as such he published, in conjunction with Admiral W. J. L. Wharton, the Society's Hints to Travellers (1883, 1889, 1893).

FRESHWATER HERRING. See Pollan.

FREYCINET, Charles Louis de Saulces de, French statesman, was born at Foix (Ariége) on Nov. 14, 1828. He was trained as an engineer, and held several important appointments, being associated with Gambetta in the war department in 1871. He was elected to the senate in 1876, and became minister of public works in the following year. From 1879 till 1880 he was minister of foreign affairs and president of the council, and these posts he held on several subsequent occasions. In 1888 he became minister for war, and continued to hold that office for five years, during two of which (1890–92) he was also premier. In 1893 he had to resign owing to the Panama scandals.

As head of the war department he did much to strengthen and develop the French army. He is the author of several important works on engineering and sanitation, and of La Guerre en Province pendant le Siège de Paris (1871). In 1890 he was elected to the French Academy.

FREYTAG, GUSTAV, German novelist and dramatist, was born at Kreuzburg in Silesia on July 13, 1816, and was educated in the universities of Breslau and Berlin. He had already gained some reputation as a dramatist when, in 1848, he became joint-editor of the Grenzboten, a Leipzig newspaper with which he was long connected. His excellent comedy, Die Journalisten, appeared in 1854, and in the following year he published his popular novel, Soll und Haben (Debit and Credit), which has been translated into most European languages. Die Verlorene Handschrift (The Lost Manuscript) followed in 1864, and in 1859 62 appeared his Bilder aus der Deutschen Vergangenheit (Pictures from the German Past). Die Ahnen (The Ancestors), a series of historical romances, appeared at intervals from 1872 to 1880. He died in Wiesbaden on April 30, 1895.

FRITH, WILLIAM POWELL, painter, was born at Studley, near Ripon, on Jan. 9, 1819. He was educated at Knaresborough and Dover, and at the age of sixteen he entered the Art Academy of Mr. Sass in London. Since 1840, when he exhibited Malvolio before Olivia at the Royal Academy, he has produced a great number of scenes from Shakspere, Molière, Dickens, Sterne, Goldsmith, &c., besides his immensely popular pictures, Coming of Age in the Olden Time (1849), Life at the Sea-side (1854), The Derby Day (1858), The Railway Station (1862), Before Dinner at Boswell's Lodgings (1868—sold in 1875 for £4567), The Private View at the Royal Academy (1881), &c. He was commissioned by the queen to paint the marriage of the Prince of Wales. He was elected R.A. in 1852, and is a member of several foreign academies. In 1890 he was placed on the list of retired academicians. His works do not exhibit the highest qualities of art, but, possibly in part because of this, they have been extremely popular. Large engravings have been produced from a number of his pictures. In 1887–88 he published his autobiography, 3 vols. 8vo.

FROEBEL, FRIEDRICH WILHELM AUGUST, German educationist, was born at Oberweissbach in Thuringia on April 21, 1782, and died at Marienthal on July 21, 1852. The death of his father in 1802 interrupted his studies, and after an unsettled and aimless period, and with somewhat imperfect culture, he started teaching. About this time he became intimate with Pestalozzi in Switzerland, and he began serious consideration of the problem of education. He served in the War of Liberation, and on his return established a school at Keilhau in 1817, in order to apply the principles of education which he expounded later in his Die Menschenerziehung (1826). In 1836 he started at Blankenburg another school for the purpose of carrying into practice his ideas in regard to the education of very young children. His system is now well known and widely employed under the name of Kindergarten (which see in SUPP.). In this work he was occupied till his death. In addition to his work on education he published Mutter-und-Koselieder, a book of poetry and pictures for children. The educational ideal of Froebel was a simultaneous development of all the activities of the individual, as opposed to the excessive training of the intellect at the expense of, and without reference to, moral and æsthetic considerations. A Froebel Society, for the promotion of the kindergarten system, was established in 1874.

FROG-SPIT, same as CUCKOO-SPIT (which see in SUPP.).

FROTH-FLY, FROTH-HOPPER, the common name of insects of the family Cercopidæ, the larvæ and pupæ of which are found in a frothy exudation on plants. See CUCKOO-SPIT in SUPP.

FRUIT-PIGEON, the name given to the pigeons of the genus *Carpophaga*, birds of very brilliant plumage, occurring in India, the warmer parts of Australia, &c. They are so called because they feed entirely on fruit.

FU-CHOW. See FOO-CHOW.

FUCUS, a genus of sea-weeds, family Fucaceæ, comprising various common sea-weeds which have a flat or compressed forked frond, sometimes containing air-vessels. Many of the species are exposed at low-water; they form a considerable proportion of the sea-weeds thrown up on some coasts, and are used for manure and for making kelp. Most contain iodine. The best-known and most useful species are *F. vesiculosus*, the Bladder-wrack, with entire fronds and air-vessels in pairs; and *F. nodosus*, the Knobbed-wrack, with air-vessels not paired. See FUCACEÆ.

FUJI-YAMA, or FUSI-YAMA, a dormant volcano of a symmetrical cone-like shape, in the island of Hondo, Japan, about 60 miles from the capital city, the sacred mountain of the Japanese. It has been quiescent since 1707; is 12,400 feet in height, and is visible in clear weather for a distance of nearly a hundred miles.

FUKUI, a town of Japan, about the middle of the province of Echizen in Hondo. It stands in the region where the ravages of the earthquake of 1891–92 were greatest. Pop. (1895), 44,128.

FUKUOKA, a town of Japan, on the N.W. coast of Kiu-Shiu, some 60 miles in a north-easterly direction from Nagasaki. It stands at the head of a bay, and is a place of great trade. Pop. (1895), 60,762.

FULGORA, the generic name of the lantern-flies (which see).

FULICA. See COOT.

FULIGULA. See POCHARD.

FUMARIA. See FUMITORY.

FURNACE, a structure in which heat is produced by the burning of some kind of fuel and utilized for some definite purpose, industrial or other. Furnaces may be classified in several different ways, as, for instance, according to their industrial application, the kind of fuel used, the way in which the heat produced is utilized, or in accordance with their general structure. In some cases the heat generated is an object in itself, as in the heating of houses, workshops, &c., whilst in others it effects a change in the physical or the chemical properties of some substances, as in annealing furnaces, blast-furnaces, &c. The heat available for the purposes of the furnace resides partly in the fuel itself, and partly in the combustible gases and gaseous products and in the nitrogen which passes over with them. (See FUEL.) Furnaces may therefore be divided into two classes, according as the desired end is secured by means of the heat of the glowing fuel, or by utilizing the issuing mixture of gases and gaseous products. In furnaces of the latter kind, exemplified in reverberatory furnaces (which see), there is a heating or working chamber distinct from, though in communication with, the fire- or combustion-chamber. In both types the body to be exposed to the influence of heat may be inclosed in some kind of vessel, such as a crucible or muffle. In many cases the furnace proper is so intimately associated with the technical process to which it is applied that it cannot be conveniently treated apart. Furnaces of this kind, such as the blast-furnace

are described in the articles GLASS, IRON, STEEL, &c. Furnaces may also be conveniently classified according to the kind of fuel used in them: thus there are solid-fuel, liquid-fuel, and gaseous-fuel furnaces. Of the first kind the ordinary open-chimney fire is the simplest example; but when, as in most industrial processes, the heat produced is to be restricted to a definite space and not allowed to radiate in all directions, the fire must be properly inclosed. When the fire is inclosed all round, openings must be provided for the access of the air necessary to combustion, for the exit of waste gases, for introducing the charge of fuel, for removing the ash and other waste solid products. The fuel is introduced through a fire-door and placed on a fire-grate, which may be simply a plate pierced with numerous holes, but usually consists of a series of cast-iron bars. The draught of air enters the furnace below the fire-door and passes upward through the grate and the glowing fuel. The resulting gases mingle with one another in the combustion-chamber, of which the grate forms the base, and are then drawn into the heating-chamber immediately behind, out of which they pass to the chimney and thence to the outer atmosphere. The opening through which the generated gases pass into the heating-chamber is usually narrowed by the insertion of a fire-bridge, which serves the double purpose of keeping the fuel in place and securing the thorough mixing of the evolved gases. The walls must be fire-proof, and sufficiently thick to keep the heat from being dissipated. Special coatings for both the inside and the outside of the walls are also desirable. An ordinary furnace of this kind has a horizontal fire-grate, and the fire-chamber in front of the heating-chamber, but the fire-grate may be inclined or stepped, and the fire-chamber may be placed under the heating-chamber, or built into it, as in steam-boilers. Since much depends on the proper control of the combustion, openings in the fire-door and in the side of the heating-chamber are usually made for purposes of observation. The regulation of the air-draught is a matter of importance, and proper feeding has much to do with efficiency. If the fuel be too fine or close-packed, the air cannot pass freely through; but if, on the other hand, it be in too large pieces, the air-draught is not fully utilized. The pieces should be about the size of one's fist for the most efficient combustion. Furnaces like the above, with a plane horizontal fire-grate, are among the simplest of all furnaces, and under proper conditions they are as efficient and economical as most others. All kinds of coal can be used in them, and they can be adapted for all technical purposes. Their advantages are, however, counterbalanced by several disadvantages, of which the most serious is the difficulty of keeping the grate supplied with fuel in sufficient quantity properly distributed over its surface. The charging with fuel and the removal of solid waste products also necessitate frequent interruptions of the process, and too much is dependent on the careful observation and management of the person in charge. Better results are obtained by substituting for the plane horizontal grate an inclined grate, and if the grate be not only inclined but also made of successive small steps, a uniform distribution of the fuel can be more readily attained. The lower end of the inclined grate does not reach quite to the wall of the chamber, and the interval is occupied either by a small horizontal grate, or by a heap of ashes, or by the surface of water filling the lower part of the ash-chamber. In this type of furnace the removal of the ashes and the feeding can be accomplished without any interruption of the process of combustion, but only particular varieties of fuel are suitable, and there are, besides, other disadvantages not found in the furnace with a horizontal grate. In the case of furnaces in which finely-powdered coal or coal-dust is used as fuel, no grate of any kind is required, and the difficulties of proper feeding are altogether absent. In coal-dust furnaces there are, of course, no solid waste products to remove. Liquid-fuel furnaces in their general arrangement are similar in character (see FUEL).

Those furnaces in which gaseous fuel is burned form a class of considerable importance. The gas to be consumed and the air to be used in the combustion are introduced into the combustion-chamber by separate pipes or openings, preferably in parallel streams near to each other, or in opposite directions along one channel so as to mingle before entering the chamber. The fuel may be either some naturally-occurring gas, or one specially manufactured for the purpose, or the by-product of some other industrial process, for example, the waste gases of the blast-furnace. Four methods of preparing fuel gases are distinguished: dry distillation, as in the case of coal-gas; preparation from oils; the *producer* method; and the water-gas method. Producer-gas was first introduced by Siemens. Regenerators are furnaces in which the gaseous fuel and the air to be mixed with it are heated before combustion with a view to increasing the working temperature of the furnace. The advantages of gas furnaces may be briefly summarized thus: no ashes or slag, high temperature, certainty of action and capability of exact regulation, simplification of working power, comparative cheapness, and economy. The electric current has been successfully utilized in the production of heat for chemical and metallurgical operations, and in this way temperatures otherwise unattainable have been reached. In such furnaces the electric arc (or a group of arcs) is utilized in connection with proper fittings of very refractory materials, such as lime, gas-retort carbon, &c. In a simple form it may consist of a cavity in a box of refractory material, having holes on each side through which insulated carbon electrodes are inserted. In some forms the electrodes enter a crucible of carbon, plumbago, or other substance.

FURNIVALL, FREDERICK JAMES, distinguished student of old English, was born at Egham, in Surrey, on Feb. 4, 1825, his father being a surgeon. After a preliminary education at three private schools he entered University College, London, in 1841, and in the following year he went to Trinity Hall, Cambridge, where he graduated B.A. in 1846, and M.A. in 1849. He adopted the study of the law, being called to the bar in 1849, but he has devoted his life chiefly to the study of early and middle English literature; and he has been mainly instrumental in establishing the Early English Text Society, the Chaucer Society, the New Shakspeare Society, the Browning Society, the Wickliffe Society, and the Shelley Society. He is also honorary secretary of the Philological Society. The societies named have given a powerful impulse to English scholarship by their publications, and this is in no small measure due to Dr. Furnivall. For them and for the Roxburghe Club and the Rolls Series he has edited numerous works, notably the Six-Text edition of Chaucer's Canterbury Tales (1868–75). Other works of his are: Early English Poems and Lives of the Saints (1862), Early English Meals and Manners (1867), Book of Nurture (1867), Education in Early England (1867), Bibliography of Browning (1881), and The Fifty Earliest English Wills in Court of Probate (1882). In 1884 he received a Civil List pension, and next year the University of Berlin conferred on him the degree of Ph.D.

FU-SAN, a town and treaty-port of Corea, situated on a bay of the same name, on the south-east coast. Its trade, which is considerable, is mostly controlled by the Japanese. A cable connects it with Nagasaki in Japan, and there is a regular steamboat service to the chief neighbouring ports.

FUSI-YAMA. See FUJI-YAMA in SUPP.

FUTEHPUR. See FATEHPUR in SUPP.

FUTTYGURH. See FATEGARH in SUPP.

G.

GABES. Same as CABES.

GABORIAU, ÉMILE, a French novelist, was born at Saujon (Charente-Inférieure) on Nov. 9, 1835, and died in Paris on Sept. 28, 1873. He was at first a clerk and afterwards served in a cavalry regiment, but the success of some early literary efforts induced him to devote himself to story-writing. After contributing to the smaller Parisian journals short sketches published under the titles Ruses d'Amour, Les Comédiennes Adorées, &c., he achieved a considerable success by his novel Dossier No. 113 (1867). He continued to work this vein in a series of clever stories dealing with crime and its detection: Le Crime d'Orcival (1867), Monsieur Lecoq (1869), Les Esclaves de Paris (1869), La Vie Infernale (1870), La Corde au Cou (1873), L'Argent des Autres (1874), &c. His novels depend for their interest on the close reasoning and observation by means of which crimes apparently beyond elucidation are cleared up step by step. This method was also that adopted by Poe, and more recently it has been employed by Sir A. Conan Doyle in his Sherlock Holmes stories.

GADE, NIELS WILHELM, one of the leading Scandinavian composers, was born on Feb. 22, 1817, at Copenhagen, where, in 1841, by his overture entitled Echoes of Ossian, he gained the prize of the Musical Union. He was supported during his studies abroad by a royal stipend, and in 1844 was appointed to succeed Mendelssohn in the direction of the Gewandhaus concerts at Leipzig. In 1850 he was appointed musical director to the King of Denmark, and in 1876 received a life pension. His works, which are Mendelssohnian in character, include seven symphonies, several overtures, sonatas, quintets, &c.; a lyrical drama, Comala; a religious cantata, The Crusaders; an opera, the Nibelungen; &c. He died on Dec. 21, 1890.

GADES, the ancient name of Cadiz.

GAEKWAR, or GAIKWAR. See GUICOWAR'S DOMINIONS.

GALILEE, SEA OF. See GENNESARET, SEA OF.

GALL-INSECTS. See GALL-FLY.

GALSTON, a town of Scotland, in the county of Ayr, on the Irvine, 5 miles east of Kilmarnock. It has manufactures of lace, muslin, &c., and there are coal-mines adjacent. Pop. (1901), 4876.

GALT, a town of Canada, in the province of Ontario, 25 miles W.N.W. Hamilton, with which it is connected by rail. It has manufactures of machinery, paper, &c. Pop. (1901), 7866.

GALTON, FRANCIS, traveller and anthropologist, grandson of Erasmus Darwin and cousin of the celebrated naturalist, was born at Duddeston, near Birmingham, in 1822. He received his earlier education in King Edward's School, Birmingham, and afterwards studied medicine at Birmingham Hospital and King's College, London. He then went to Trinity College, Cambridge, where he graduated as B.A. in 1844, and as M.A. in 1847. Being possessed of private means, and his attention having been directed to Africa, during 1850–52 he explored Damaraland and other parts of South Africa, and published an account of his visit in a work entitled Narrative of an Explorer in Tropical South Africa (1853). His journeys extended over about 2000 miles, and the Royal Geographical Society awarded the explorer a gold medal in recognition of the value of the information accumulated. His Art of Travel, or Shifts and Contrivances in Wild Countries (1855), went through five editions in seventeen years, and his Meteorographica, published in 1863, contained much original work in meteorology. In 1860–63 he edited three volumes of Vacation Tours and Notes of Travel. He has given much attention to anthropology and kindred subjects. Since about 1869 his work has been largely directed to the elucidation of the difficult questions connected with heredity and the development of the faculties, and in this department his results are of the highest importance. They are chiefly set forth in the following works:—Hereditary Genius, its Laws and Consequences (1869); Experiments in Pangenesis (1871); English Men of Science, their Nature and Nurture (1874); Inquiries into Human Faculty and its Development (1883); Natural Inheritance (1889); Finger Prints (1893); Finger Print Directory (1895).

GALVANOPLASTY, another name for electrometallurgy (which see).

GAMA-GRASS. See BUFFALO-GRASS in SUPP.

GANGLION, in anatomy, an enlargement occurring somewhere in the course of a nerve, and containing nerve-cells in addition to nerve-filaments. There are two systems of nerves which have ganglia upon them. First, those of common sensation, whose ganglia are near to the origin of the nerve in the spinal cord. Secondly, the great sympathetic nerve, which has ganglia on various parts of it. In the invertebrates, ganglia are centres of nervous force, and are distributed through the body in pairs, one for each ring of the body, connected by fibres. The cerebral ganglia of vertebrates are the brain itself, the masses of gray matter at the base of the brain, as the optic thalamus, &c. See NERVE, BRAIN.

GANGUE, a mineral substance surrounding a metallic ore in a vein. Gangues are usually of quartz, but other matrices are found.

GAPES, a disease of fowls and other Rasorial birds, arising from the presence in the windpipe of small parasitic worms (*Fasciola trachealis*), which cause the bird to continually open its beak. They may be dislodged with an oiled feather, or by mixing a little Epsom salts with the food. See POULTRY.

GARDENIA, a genus of trees and shrubs of the natural order Cinchonaceæ, natives of tropical Asia and Africa, bearing beautiful white or yellowish flowers of great fragrance. *G. florida* and *G. radicans* are well known in Britain as Cape jasmine, though natives of Japan. A resin and other products are obtained from some species.

GARDEN-WARBLER (*Sylvia* or *Curruca hor*

tensis), a migratory song-bird visiting Britain from the end of April to September, and ranking next to the blackcap as a songster. It is rather less than 6 inches long, the head and upper surface greenish-brown, the under surface brownish-white. The song is wild and irregular, with considerable range. See WHITE-THROAT.

GARDINER, SAMUEL RAWSON, D.C.L., LL.D., English historian, was born at Ropley, Hants, on March 4, 1829, and educated at Winchester and Christ Church, Oxford, where he took first-class honours in classics in 1851. He was for some years professor of modern history at King's College, London, but resigned in 1885. He has specially devoted himself to the period of English history from the accession of James I. to the Commonwealth, and has given a full and impartial account of the events of the time, based on the original documents. His works on this period are: History of England from the accession of James I. to the Disgrace of Coke (1863); Prince Charles and the Spanish Marriage (1869); England under Buckingham and Charles I. (1875); The Personal Government of Charles I. (1877); The Fall of the Monarchy of Charles I. (first two vols., 1882), all these being republished in 1883–84 as a History of England from 1603 till 1642; History of the Civil War (four vols., 1893); History of the Commonwealth and Protectorate (vol. i., 1894; vol. ii., 1897); The First Two Stuarts and the Puritan Revolution (1875); Cromwell's Place in History (1897); and What the Gunpowder Plot was (1897). Besides these, he wrote an admirable Student's History of England, a little book on The Thirty Years' War, and Introduction to the Study of English History (with Mr. B. Mullinger). In 1882 he received a civil list pension. He died on Feb. 23, 1902.

GARNETT, RICHARD, English writer, was born at Lichfield on Feb. 27, 1835, his father being Rev. Richard Garnett, assistant keeper of printed books in the British Museum. He was educated privately, and at the age of sixteen became an assistant in the printed book department of the British Museum. In 1875 he was appointed assistant keeper, and in 1890 keeper of printed books. He retired from the latter post in 1899. From 1875 till 1884 he was superintendent of the reading-room. He received the honorary degree of LL.D. from Edinburgh University in 1883, and in 1895 he was created a Companion of the Bath. Besides many articles in periodicals and encyclopædias he has written—Primula: a Book of Lyrics (1858); Io in Egypt, and other Poems (1859); Poems from the German (1862); Relics of Shelley (1862); Idylls and Epigrams, chiefly from the Greek anthology (1869); Life of Carlyle (1887); Life of Emerson (1888); The Twilight of the Gods, and other Tales (1888); Life of Milton (1890); Poems (1893); The Age of Dryden (1895); Sonnets from Dante, Petrarch, and Camoens (1896); William Blake, Painter and Poet (1898); History of Italian Literature (1898); Life of E. G. Wakefield (1898); and Essays on Librarianship and Bibliography (1899). He has also edited various works, and has assisted in the preparation of the general catalogue of the Museum Library.

GARRISON, WILLIAM LLOYD, American journalist and founder of the anti-slavery movement in the United States, was born at Newburyport, Massachusetts, on Dec. 10, 1805. He was apprenticed to a shoemaker, but became a compositor, and afterwards an editor of papers. With Mr. Lundy, a Quaker, he started a paper called The Genius of Universal Emancipation (1829), his denunciation of slave-traders leading to his imprisonment for libel. On his release he commenced lecturing in Boston, started the Liberator (1831), published weekly with the aid of one assistant and a negro boy, and carried on in spite of tremendous opposition and anonymous threats. In 1832 appeared his Thoughts on African Colonization, and in the same year he established the American Anti-Slavery Society. He subsequently visited England, where he was welcomed by Wilberforce, Brougham, Buxton, and others. In 1835 he was saved with difficulty from a Boston mob; but his principles made steady progress until 1865, when the Anti-Slavery Society was dissolved with its work accomplished. He died at New York on May 24, 1879. A volume of sonnets (1847) and one of selections (1852) bear his name. See William Lloyd Garrison: the Story of his Life as Told by His Children (four vols., 1885–89), and a biographical essay founded on it by Professor Goldwin Smith (1892).

GARTER-FISH. See SCABBARD-FISH.

GARVIE, GARVIE HERRING, the name in Scotland for the sprat, *Harengula* (*Clupea*) *sprattus*.

GASCOIGNE, GEORGE, English poet, was born about 1525, educated at Cambridge, and admitted to Gray's Inn in 1555. Being disinherited by his father on account of his gaming and extravagance, he served with distinction in Holland and was made prisoner by the Spaniards, but returned safely to England, and died at Stamford on Oct. 7, 1577. He is chiefly remembered for his blank-verse satire, The Steele Glas (1576), and the Complaynt of Philomene, a rhyming elegy (1576), but he wrote two or three comedies and tragedies. See his Life and Writings, edited by Prof. F. E. Schelling (Boston, 1893).

GAS-ENGINE, an engine in which the movement of the piston is caused by the explosive energy of a mixture of inflammable gas with atmospheric air. Early attempts at the construction of machines working on this principle were made by Huyghens, Papin, and others, the explosive agent being gunpowder, but no industrially useful results were obtained in this direction for a long period. In 1799 an engine was devised and patented by a French artisan named Lebon, which was in every essential particular identical in principle and construction with the most successful engines of our day. It had the general form of a reciprocating steam-engine, and wrought as follows:—From a reservoir sufficiently supplied with coal-gas a certain measured charge was introduced, mixed with a similarly measured charge of atmospheric air, into the cylinder on alternate sides of the piston successively, and this mixture was exploded by an electric spark. The disproportionate expense of producing the gas at a time when it had not been used as a means of artificial lighting was fatal to the commercial success of the invention. A close reproduction of this engine was patented in France in 1860 by an inventor named Lenoir. The gas-engine invented by Otto and Langen of Cologne consists of an upright cylinder in which works a heavy piston, the rod of which forms a rack gearing with a cog-wheel on the shaft of the fly-wheel; as the piston ascends, the cog-wheel slips loosely on the shaft; as it descends, its energy is transferred to the shaft through the cog-wheel just mentioned, the force of down-stroke being due to the rapid condensation of the gases after the explosion, aided by the weight of the piston itself. The mixed gases—common coal-gas and air—are introduced at the base of the cylinder, and fired by communication with a gas-jet which is kept constantly burning. The Otto horizontal gas-engine has now superseded the Otto-Langen upright one. Numerous varieties of gas-engines have subsequently been introduced, the improvements aimed at being

smoothness in working, simplicity in structure, and economy. Although usually operated by coal-gas, the vapour of any volatile hydrocarbon (as petroleum) will serve equally well. The expense for gas is found to average about a penny per hour for every horse-power. Gas-engines are now usually grouped in two chief classes, namely: (1) those in which the gaseous mixture is not compressed before entering the cylinder, and in this case the explosive force may operate on the piston either directly (Lenoir) or indirectly (Otto-Langen); (2) those in which the gaseous mixture is compressed before entering the cylinder, a type represented in one form by the Clerk, the Griffin, the Day, and the new Otto, and in another by the Brayton, the Siemens, and others.

GASTEROSTEUS, a genus of Teleostean fishes. See STICKLEBACK.

GAUR, GOUR, known to sportsmen in India as the bison, one of the largest of all the ox tribe (*Bos gaurus* or *Bibos gaurus*), inhabiting the mountain jungles of India, remarkable for the extraordinary elevation of its spinal ridge, the absence of a dewlap, and its white 'stockings', which reach above the knee. It is so fierce when roused that neither tiger, rhinoceros, nor elephant dare attack it. The hide on the shoulders and hind-quarters is sometimes nearly 2 inches in thickness even after being dried, and is therefore much valued for the purpose of being manufactured into shields. The average height of a gaur at the shoulder is about 5½ feet. The animal is supposed to be incapable of domestication. Gaur-shooting is one of the chief rifle-sports of India.

GAUTAMA, a name of Buddha, the founder of Buddhism. See BUDDHA.

GAVAZZI, ALESSANDRO, popular Italian preacher and religious reformer, was born at Bologna in 1809, and died at Rome on Jan. 9, 1889. At the age of fifteen he became a monk of the Barnabite order, at twenty he was professor of rhetoric in the College of Naples, and soon after made his mark as a pulpit orator. In 1846 he was chaplain-general of the Roman patriotic league. Subsequently he threw off his papal allegiance and joined the agitation which ended in the short-lived republic. The French occupation of Rome drove him into exile, when he travelled through Britain and America lecturing against the Church of Rome, his power as an orator evoking much enthusiasm. He was with Garibaldi in 1860, and made subsequent visits to Britain, gathering funds for the Free Italian (Protestant) Church, in the interests of which he lectured, preached, and travelled on deputation work till his death.

GAYAL, GYAL, or MITHAN, a species of ox (*Bos frontalis*), closely related to the gaur, found wild in the mountains of Northern Burmah and Assam, and long domesticated in these countries and in the eastern parts of Bengal. It is rather smaller than the gaur, to which it bears a considerable resemblance. Its milk is exceedingly rich, though not abundant. See GAUR above.

GEAN, a kind of wild-cherry tree (*Prunus Avium*), common in Britain. The numerous varieties of cherries in cultivation are derived partly from the gean and partly from an allied species. See CHERRY.

GEBWEILER. See GUEBWILLER.

GEIBEL, EMANUEL, German poet, who was born at Lübeck on October 18, 1815, and died there on April 6, 1884. He studied at the universities of Bonn and Berlin, and resided a year or two in Greece. He published his first collection of poems in 1840, which reached its hundredth edition in 1884. In 1843 he published a tragedy, King Roderick; in 1846 the epic König Sigurd's Brautfahrt. A second collection of his poems appeared in 1848—Juniuslieder (June-songs). A third collection of poems was published by him in 1857, a fourth in 1864. From 1851 to 1869 he was honorary professor of æsthetics and poetry in the University of Munich, but spent his latter days in his native town. He wrote also Brunhild, a tragedy; The Loreley, an opera in rhyme; and several other plays, but his fame rests on his lyrics, which are immensely popular. His collected works were published in 1883 (Stuttgart, 8 vols., 3rd edn. 1893).

GEIKIE, SIR ARCHIBALD, geologist, was born at Edinburgh on December 28, 1835. He was educated at the High School and university of his native city, and received an appointment on the Geological Survey of Scotland at the age of twenty. In 1867 he was appointed director of the Survey, and from 1871 till 1882 he was also Murchison professor of Geology and Mineralogy in Edinburgh University, being the first occupant of that chair. At the close of 1881 he succeeded Sir Andrew C. Ramsay as director-general of the Geological Survey of the United Kingdom (from which post he retired early in 1901), and director of the Museum of Practical Geology, London. From 1890 till 1894 he was foreign secretary to the Royal Society, and he has been president of the Geological Society (1891–92) and of the British Association (1892). In 1891 he received the honour of knighthood. His numerous works, mostly on geological subjects, are admirably written, and many of them, especially his excellent manuals, are well known. They include: The Story of a Boulder (1858); Memoirs of Edward Forbes (1861, with G. Wilson); The Phenomena of the Glacial Drift of Scotland (1863); The Scenery of Scotland viewed in connection with its Physical Geology (1865, 3rd edn. 1901); Memoir of J. D. Forbes (1869); Life of Sir R. Murchison (1875); Class-book of Physical Geography (1877); Outlines of Field-Geology (1879); Geological Sketches at Home and Abroad (1882); Text-book of Geology (1882, 3rd edn. 1893); Class-book of Geology (1886); Memoir of Sir A. C. Ramsay (1895); The Ancient Volcanoes of Britain (1897); The Founders of Geology (1897); and Types of Scenery, with their Influence on Literature (Romanes Lecture, 1898). His Geological Maps of Scotland (1892) and of England and Wales (1897) should also be mentioned. He is LL.D. of St. Andrews (1872) and Edinburgh (1885), and D.Sc. of Cambridge and Dublin. Many foreign academies, including the Institute of France, have elected him a corresponding member.

GEIKIE, JAMES, LL.D., geologist, younger brother of Sir Archibald Geikie, was born at Edinburgh on August 23, 1839. Educated at the High School and university of that city, he in 1861 joined the Geological Survey. Eight years later he was appointed district surveyor, a post which he occupied till 1882, when, on his brother's appointment as director-general of the United Kingdom Survey, he succeeded him as Murchison professor of Geology and Mineralogy in the University of Edinburgh. He holds several honorary degrees, and is connected with many foreign scientific bodies. He was one of the founders of the Royal Scottish Geographical Society, and is the honorary editor of its monthly magazine. Of his writings on geological subjects we may mention: The Great Ice Age, and its Relation to the Antiquity of Man (1874, 3rd edn. 1894); Prehistoric Europe, a Geological Sketch (1882); Outlines of Geology, for students and general readers (1884,

3rd edn. 1896); Fragments of Earth-lore (1892); and Earth Sculpture (1898). He has also published some translations from the German under the title Songs and Lyrics by Heinrich Heine and other German Poets (1887).

GELDER-ROSE. See GUELDER-ROSE.

GELLIVARA, an extensive commune or parish in northern Sweden, famous for its rich deposits of iron ore. At one time all the ore was conveyed by railway to Luleå, on the Gulf of Bothnia, and shipped there; but a line has been made to Narvik on the Ofoten Fjord, on the Norwegian coast, where quays and other works have been constructed for its shipment, and a small town has grown up.

GELSEMIUM, a genus of plants belonging to the natural order Loganiaceæ, the best-known, *G. nitidum* or Carolina jasmine, being an evergreen clinging shrub of the Southern States of America, with twigs producing a milky juice, opposite lance-shaped shining leaves, and sweet-scented yellow flowers. The root has valuable medicinal properties, due to the presence of an alkaloid, gelsemine. It acts on the nervous system so as to dull sensibility, but in overdoses it may result in death.

GELSENKIRCHEN, a town of Prussia, in the province of Westphalia, close to the border of the Rhine Province, a few miles north-east of Essen and north-west of Bochum. It has grown up since about 1850, its rise being due to its iron and coal industries, which it shares with the neighbouring towns. Pop. in 1895, 31,582; in 1900, 36,841.

GEMBLOUX, an old Belgian town in the province of Namur, 24 miles S.E. of Brussels. It has a Benedictine abbey of the ninth century, now used as a royal agricultural institution. Here, on Jan. 31, 1578, Don John of Austria defeated a body of Netherland troops. Pop. (1900), 4216.

GENERAL OFFICER, in the army, an officer higher in rank than a colonel. See GENERAL.

GENEVA ARBITRATION. See ALABAMA, THE.

GENTIANACEÆ, the gentians, an order of gamopetalous dicotyledons, consisting mostly of annual or perennial herbaceous plants, with opposite often connate entire leaves, and yellow, red, blue, or white flowers, which are borne in dichotomous or trichotomous cymes or in globose terminal heads. All are characterized by their bitter principle. The order contains many species, which are widely dispersed, but occur most plentifully in temperate mountainous regions. Some very handsome species are tropical, while a few occur in Arctic latitudes. The chief genera are *Gentiana* (gentian), *Menyanthes* (bog-bean), and *Erythræa* (centaury). See GENTIAN.

GEORGE, HENRY, American writer on political economy and social reform, was born in Philadelphia on September 2, 1839. On leaving school he served as a clerk for a short period, and afterwards went to sea. Arriving in California in 1858, he worked as a compositor, and subsequently became editor of some local papers. In 1879 he published his work entitled Progress and Poverty, which attained an enormous circulation, not only in the United States, but in England and elsewhere. It is described as 'an inquiry into the cause of industrial depressions, and of increase of want with increase of wealth', and in it many of the older views of wealth, wages, and capital are attacked. The conclusion at which he finally arrived was that all taxes should be replaced by a single tax levied on land values, thus practically making and recognizing land as national property whilst still leaving it in the possession of individuals. This work naturally evoked many replies, and its reasoning was much more specious than conclusive. In 1880 Mr. George removed to New York, where he mainly resided till his death on October 29, 1897. He visited and lectured in the United Kingdom in 1881–82, 1883–84, 1884–85, and 1889; and in 1890 he was in Australia. His other works include: Our Land and Land Policy (1871); The Irish Land Question (1881); Social Problems (1884); Property in Land, a controversy with the Duke of Argyll (1884); Protection or Free Trade, a brilliant defence of freedom of trade (1886); The Condition of Labour: an Open Letter to Pope Leo XIII. (1891); and A Perplexed Philosopher, a vigorous criticism of Herbert Spencer's various utterances on the land question (1893).

GEORGE TOWN. See PENANG.

GEORGIA BARK. See PINCKNEYA PUBENS.

GERFALCON. See FALCON.

GÉRICAULT, JEAN LOUIS THÉODORE ANDRÉ, French painter, was born at Rouen on Sept. 26, 1791. He came to Paris in 1806 and studied under Charles Vernet and Guérin. His first pictures (the Chasseur Officer and the Wounded Cuirassier) were exhibited in 1812 and 1814. In 1817 he visited Italy, returned to Paris in 1819, and painted the Raft of the Medusa (a well-known shipwreck of the time), a work of much power, which won immediate popularity when exhibited in London, where he lived for a few years. On his return to Paris he exhibited Le grand Derby d'Epsom, and among his subsequent pictures are La Charrette des Charbonniers, Le Maréchal ferrant, L'Enfant donnant à Manger à un Cheval, La Traite des Nègres, and L'Ouverture des Portes de l'Inquisition, the last two being unfinished. He also gained some success in sculpture. He died at Paris on Jan. 26, 1824. Géricault's work represents a revolt against the classical school of David which came to the front during the revolution. In the pensiveness and the profound sympathy with the oppressed and the suffering which stamp all his pictures he has much in common with Jean François Millet.

GERKI, a town of Sokoto in Northern Nigeria, a busy trading-place. Pop. 15,000.

GERM, in physiology, the earliest form under which any organism appears, that is, the rudimentary or embryonic form of an organism. The name is also given to certain minute organisms which give rise to disease. See GERM THEORY OF DISEASE in SUPP.

GERMANDER, the common name of three British plants of the genus *Teucrium*, order Labiatæ, namely, *T. Chamædrys*, common or wall-germander; *T. Scordium*, water-germander; and *T. Scorodonia*, wood-germander or wood-sage. They were all formerly used in medicine, and are still employed by country herbalists. Two species belong to North America, *T. canadense* and *T. virginicum*. Wood-sage, so named from the resemblance of its leaves to those of the true sage, has a hop-like taste and smell, which have led to its use as a hop-substitute in some parts.

GERMANDER SPEEDWELL (*Veronica Chamædrys*), a well-known British plant with beautiful blue flowers which appear in spring. Like the other species of its genus, it has a rotate corolla with four unequal lobes and a very short tube. The number of its stamens is two. See SPEEDWELL in SUPP.

GERMAN EAST AFRICA. See EAST AFRICA (GERMAN) in SUPP.

GERMAN SOUTH-WEST AFRICA. See SOUTH-WEST AFRICA (GERMAN) in SUPP.

GERMERSHEIM, a town and fortress in the Bavarian Palatinate on the Rhine, 8 miles S.W. of Speier. It was in the possession of France during a part of the seventeenth century, and here in 1793

the French under Beauharnais were defeated by the Austrians. Pop. (1895), 5736.

GERM THEORY OF DISEASE, THE, the theory that certain diseases owe their origin to living germs of one kind or other that gain entrance into the system of the persons attacked. That certain diseases are contagious has long been known, and not only has it been shown that contagious diseases are communicable from person to person, but it has been proved beyond question that the clothes worn by the sick person, the bed upon which he lay, the books, toys, and other things he has handled, the carpets or floor upon which he trod, nay, the walls of the room in which he lived, have acquired the power of communicating the disease. Various views have been held regarding the nature of such contagion, but the opinion is now general, that material particles leave the body of the sick and pass into the organism of the person attacked; that these material particles may retain their peculiar properties for some time after they have left the organism in which they were formed—nay, that they may grow and multiply and give rise to multitudes of new particles having similar properties—that, in short, the particles exhibit the peculiarities which distinguish all living forms from non-living matter, and that they only lose their virulent disease-producing powers when they die or when they are destroyed by chlorine, sulphurous acid, chloride of zinc, carbolic acid, or other disinfecting substance. The disease-carrying particle grows and multiplies in the organism it invades, and in many instances to such an extent does this proceed, that not a particle of the blood or other fluids, or of the moist tissues, can be obtained which is not fully impregnated with the contagious material. Although, therefore, but one or a very few particles of a *contagious virus* may enter a living body, millions may in a short time be given off from it, and each one potent to produce the disease.

The period during which the living particles of contagious matter retain their vitality, like the rate of their growth and multiplication, varies in different cases, but it is limited in all. Every contagious particle, like every other living form, must die, but the power of resistance, or, in other words, the capacity of living under adverse circumstances, is by no means the same,—for some forms of contagious matter may be dried without their potency being lost, while others deteriorate in activity after being removed from the medium in which they were formed. Few, if any, resist the destructive influence of a temperature of 300° Fahrenheit, while most succumb at the temperature of 200° or even less, particularly if exposed for some time. Animal poisons generally are destroyed by boiling, and clothes, sheets, &c., infected, may be rendered pure by being sufficiently heated; but it must be borne in mind that every part of the article, to be effectually 'disinfected', must be exposed to a somewhat higher temperature. In practice it has been found that prolonged exposure to heated air of a temperature of 300° in an oven is required to effectually disinfect blankets, bedding, &c., and to destroy the ova of parasites and other organisms that may be present.

The growth and multiplication of the poison germs in the blood and fluids of the body, the fact of their transference to air or water, by which they might be carried far away from the seat of their production without losing their activity, and the disturbance evidently excited in the fluids of the body, naturally led to a comparison being made between these contagious particles and *ferments*; and the putrefaction of blood and other animal fluids is associated with the growth and multiplication of minute organisms allied to those which occasion some fermentations. The organisms in question are so very small, that if thirty thousand of some of the smallest were placed end to end they would not form a line one inch in length. These organisms, which investigations have proved to be the *cause of the putrefaction*, exist everywhere. They or their germs are present in air and in ordinary water, and there is not an object upon which multitudes may not be found. Under ordinary circumstances they remain dormant, or they multiply very slowly; but if a few gain entrance to an animal or vegetable fluid, especially if some hours have passed since its removal from the body, they soon increase and millions result.

From the rod- or staff-like appearance of these minute bodies they have been called *bacteria* (Gr. *baktērion*, a staff). This name, however, was applied to them before it was clearly recognized that even among these smallest of living things differences existed, differences so considerable as to render it necessary to distinguish various species by separate names. (Fig. 1.) Thus the *micrococcus* is

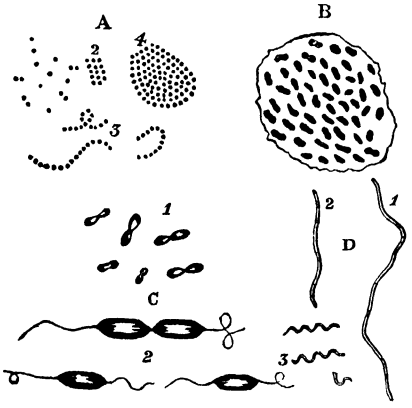


Fig. 1.—Various species of Micro-organisms. A, Micrococcus: 1, singly; 2, in groups; 3, in chains; 4, in mass. B, a mass of Bacteria (Zoogloea mass) C, Bacteria: 1, singly, constricted in the middle, as about to divide into two 2 shows, in a much more highly magnified view, the way in which one bacterium divides into two, each new unit passing off as an independent form It also shows the flagella of the bacteria. D, 1 and 2, Vibriones; 3, Spirilla. All are very highly magnified. (After Klein and Dallinger.)

a minute spherical body, sometimes no larger than the $\frac{1}{32000}$ of an inch; the minute organism to which in particular the term *bacterium* is applied is not spherical but rod-shaped, about $\frac{1}{10000}$ of an inch long and a third less in breadth, and it has rounded ends; the *bacillus* is also a rod-shaped body (Latin *bacillum*, a little rod), and rather larger than the bacterium. The bacilli are particularly apt to form long chains or threads, being strung on end to end. The *vibrio* is rod-shaped but wavy, and longer than either of the preceding two; while the *spirillum* is a spiral-shaped filament. (D 3 in Fig. 1.) These various forms were all classed at first under the one term bacteria, but to avoid confusion, all the different species are better classed together as micro-organisms, microbes, or microphytes, though many persons, speaking or writing of bacteria, mean to include micrococci, bacilli, and the other forms. The species to which the name *bacterium* particularly belongs are provided with flagella at each extremity, hair-like processes by the lashings of

which they are capable of rapid motion from place to place (Fig. 1, c). Many spirilla are also flagellate, and a few species of cocci. But the vibriones and spirilla are able to move without flagella in a wavy or spiral course according to their form, while most of the micrococci and many of the bacilli, being unprovided with any flagella, are incapable of locomotion. The chief method of multiplication of such microbes is by division. Thus, in the middle of a micrococcus, bacterium, or bacillus a constriction appears, and gradually extends till it has completely separated the organism into two. The halves separate, and each part becomes independent, having a life of its own, and capable in a very short time of itself dividing into two, each of which may also speedily divide. This process goes on so rapidly, that from one bacterium millions may be produced, under favourable conditions, within twenty-four hours. In the case of non-motile forms, varieties in the manner of grouping may be produced by the manner of multiplication. Thus, in the case of the coccus, some divide always in one axis and thus produce a chain. This species is called *streptococcus*, while others divide irregularly, producing a bunch, and this species is called *staphylococcus*. Others tend to remain in pairs—a *diplococcus*; others again divide in three axes at right angles to one another, and are referred to as *sarcinæ*. But there is another method of propagation common to the bacillus, but within recent years shown also to belong to the bacterium, the method by spore formation. The spores are eggs or seeds developed within the substance of the organism, and liberated by its breaking up. (In Fig. 2,

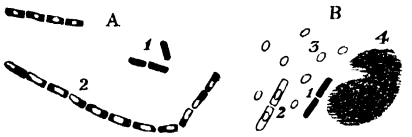


Fig. 2.—The Bacillus of ordinary putrefaction. A, 1, single bacilli; 2, bacilli forming filaments and developing spores. The bright oval body in the centre of each bacillus is a spore. B, 1, ordinary form without spores; 2, with spores; 3, free spores; 4, a mass of spores. (After Klein.)

A, spores are shown in bacilli.) If the spore settles on material fitted to nourish it, it grows into the fully mature form, and goes on multiplying by division and by the production of other spores, which are again capable of producing the parent form. But there is one great and vital distinction between the fully-mature form and the spore, and it is that the former is, as a rule, easily killed by a temperature considerably below that of boiling water, while the spore can resist boiling for some minutes, and perhaps even for hours. The spores can also withstand other unfavourable conditions. Extreme cold, as well as heat, fails to kill them, and they resist drying and the action of many chemical agents which rapidly destroy the mature organism. Thus spores may be disseminated through the air as dust, may lie inactive for long periods of time, and yet be able when surrounded by moisture, heat, and nourishment to waken up and produce the active and fully-developed form.

As there are different kinds of fermentation and putrefaction, each caused by its own specific organism or ferment, so it has been remarked are there different forms of fevers or blood fermentations affecting man and the higher animals, each running a definite course and exhibiting certain special characteristics peculiar to it, and each, it is believed, being caused by its own special living and growing *ferment*, *virus*, or *contagion*. The diseases which were caused by matter supposed to be allied to ferments were, in the year 1842, arranged by Dr. Farr in a class by themselves, and were called by him *zymotic*, a word derived from the Greek *zymōsis*, fermentation, from *zymē*, leaven. Among diseases of this kind are generally included the following:—Small-pox, measles, scarlatina, diphtheria, quinsy, croup, whooping-cough, typhus, enteric or typhoid fever, simple continued fever, erysipelas, puerperal fever, carbuncle, influenza, dysentery, diarrhœa, simple cholera, ague, remittent fever, rheumatism.

The '*germ theory of disease*' would attribute the majority, if not all, of the diseases in the above list to the action of a living organism belonging to one or other of the species described above, which had gained access to the body of the afflicted person by some channel or other, in air or food or drink, and which, in the process of its multiplication in the blood and tissues, produced the changes characteristic of the disease. But while it is true that in small-pox, in scarlatina, in diphtheria, in typhoid fever, in erysipelas, in puerperal fever, in diarrhœa and cholera, and in many other diseases, micro-organisms of some kind are found, if examined for, yet in few has a definite relationship been shown to exist between the microbe and the disease. In most of the cases, however, no thorough investigation has been made to determine whether the disease was actually the effect of the operation of minute living things or not. Where such investigations have been undertaken and persisted in, remarkable results in support of the germ theory have been obtained. The most notable instance that can be mentioned is that of splenic fever, a fever that rages on the Continent among flocks and herds, attacking horses also and man. France, Spain, Italy, Russia, and Egypt suffer severely from it. In 1850 a French doctor, Davaine, observed bacilli in animals dead of this fever, but paid little attention to his discovery. The observation was taken up by himself later and by others, and the bacillus was found to be the actual cause of the disease. Dr. Koch, of Berlin, published in 1876 a paper giving a full account of the life-history of the organism; and in 1877 the great French chemist, Pasteur, proceeded to investigate the subject. He cultivated the microbe artificially, as Koch had done, and was able at pleasure to excite splenic fever in an animal by simply injecting under its skin a few drops of fluid in which the artificially-reared bacillus was present. Hens never were found affected with splenic fever. Pasteur found that the bacillus was killed by a temperature of 44° C. The temperature of fowls is about 41° or 42°, and he thought it probable that it was the high temperature of the fowls' blood that rendered it unsuitable for the growth of the organism. He accordingly lowered the temperature of a hen's body to 37°, and injected his splenic-fever poison. The animal took the fever and died. He treated another fowl in the same way, but in the middle of the fever he warmed it up to or above its usual heat; it completely recovered. That is to say, the disease organisms in its body could not resist the high temperature, but were killed by it, and, therefore, the fever disappeared. Moreover, Pasteur found that he could cultivate the splenic-fever bacillus in an enfeebled condition, so that it was no longer able to produce a virulent form of the disease. If, however, an animal were inoculated with the mild form of the fever poison, it speedily recovered from the effects, but was then incapable of taking the violent form of disease. Many thousands of cattle were inoculated by him as a protection against the plague, with the result of greatly reducing the mortality, just as

children are inoculated or vaccinated with a mild form of pox to prevent them taking the more deadly small-pox. The splenic-fever bacillus multiplies by the formation of spores. These spores have usually been the means of communicating the disease to man. On the hide of an animal dead of the disease, spores may be developed in large numbers, owing to some blood or discharge from the animal containing the bacillus coming in contact with the hide. The hides may be dried, yet the spores do not lose their vitality. They may be transported long distances, the spores clinging just as dust would do. But as soon as these seeds of the disease, so to speak, are planted in suitable soil, out of them the fully-developed organism will grow. Now it is specially persons whose occupation was sorting wool that splenic fever has attacked. Hence it has also been called '*wool-sorter's Disease*'. There can be no doubt that by the process of sorting the wool the dry spores became detached and disseminated in the air, and, entering the bodies of the persons engaged with the wool, proceeded to develop there and produce the disease. Nothing could be found more conclusively supporting the 'germ theory' of disease than the facts regarding splenic fever.

In 1882 Dr. Koch, of Berlin, announced the discovery of a micro-organism in tuberculosis, a disease believed to be the chief, if not the only, cause of consumption of the lungs. These microbes—they are in this case also bacilli, though quite different in character from those of splenic fever—these microbes are found not only in the lungs of persons who have died of tubercle, but also in the spit of tubercular and consumptive patients. (Fig. 3.) Koch was able to cultivate the bacillus in a pure state outside of the body, and was always able to produce the disease in suitable animals by introducing some of his cultivated material into the animal's body. The bacilli of tubercle multiply also by spores. Thus it is that the spit of a consumptive patient, even after it has dried up, may be capable of imparting the disease, owing to spores being scattered in the air. An organism very like that of tubercle has been found in leprosy, while lupus, scrofula, and certain diseases of bone and joints, were shown by Koch's work to be all due to the tubercular organism.



Fig 3 – From a preparation of human tuberculous spit. The bacilli are seen in numbers.

After the epidemic of cholera in Egypt in 1883, which spread to France and Italy, investigations were undertaken to discover whether any special organism could be detected having any particular relationship to the disease. French, German, and British commissioners were appointed for this purpose. Dr. Koch, who was head of the German commission, detected a peculiar organism, shaped like a comma (,), the comma-bacillus or cholera spirillum, in the intestines of persons who had died of cholera, in the discharges from cholera patients, and also in water of which persons had drunk who had afterwards been seized with cholera. He believed that this was the active agent in the production of the disease. Animals, however, are not susceptible to cholera, and the essential link in the chain of evidence, namely, the production of cholera by the inoculation of some with the supposed cholera-organism, has not been quite satisfactorily established, though the presumption is very strong that this is the real cause of the disease. In 1885 Dr. Klein, the head of the English commission, reported as the result of his investigations his inability to accept Dr. Koch's view that the comma-bacillus was the cause of the disorder.

In the blood of persons suffering from relapsing fever another form of micro-organism—the spirillum—has been found in great numbers: as the fever passes away they gradually diminish in numbers; and during the intervals of freedom from fever they disappear from the blood. The fever has been produced in monkeys by inoculating them with human blood from a case of relapsing fever, and the spirilla have been found in numbers in the monkey's blood. A micrococcus has been found in erysipelas, and the inoculation of rabbits with the artificially-reared micrococci has produced erysipelas in them. Pneumonia, at least in some of its varieties, has been shown to be associated with a micrococcus. In the case of typhoid fever and diphtheria the causal relationship has been clearly established between the disease and a living organism of the kind under discussion. The same is true of glanders. Lastly, researches seem to prove that malaria also is due to an organism introduced into the body of a human being by the bite of a mosquito, in the body of which the malarial organism undergoes one stage of its development.

These are some of the most marked instances in which a definite relationship has been observed between a particular disease and a particular living organism. How, precisely, the organism operates in the production of the disease it is not easy to determine. It seems probable that the multiplying organism produces some chemical alterations in the blood and tissues of the animal attacked, and that the diseased conditions are the consequences of these alterations. The organism may do this by splitting up certain constituents of the blood and tissues in order to obtain what it requires for its own growth; or it may be that, in the course of its own development and multiplication, the organism produces some special substance, a ferment for example, or merely toxic or poisonous substances, and that it is owing to the operation of these substances manufactured by the microbes, that the symptoms of the disease are manifested.

It is necessary to notice that the microbes that set up putrefactive changes are quite different from those that produce specific diseases. In other words, the micro-organisms everywhere present in the atmosphere, that settle on everything exposed to the air, and set up in organic fluids and solids the putrefactive change, if introduced into the body of an animal or man will not produce any specific disease. Nay more, under ordinary circumstances the micro-organisms that excite the putrefactive change in dead organic material—in meat, milk, urine, &c., for example—cannot grow and multiply within the body of a living animal. The fact, then, that the air is swarming everywhere with the exciting causes of putrefaction need not excite alarm in the breast of the most timid. They are introduced into the body in multitudes in food and drink and in the air of respiration, but are incapable there of working any evil. Moreover, it does not appear that these microbes can be transformed by any extraordinary conditions, or any association of circumstances, into forms capable of acting in a virulent manner upon the living body. There are bacteria which, introduced into the living animal, set up blood-poisoning, but they

are not the ordinary bacteria of putrefaction, but special septic bacteria, the offspring of bacteria like themselves, exhibiting similar septic properties.

On the other hand, the *pathogenic* organisms, as they are called, that is, the organisms which beget unhealthy conditions, are capable of living and flourishing in the living body, as has been sufficiently illustrated by the cases of splenic fever, tuberculosis, &c. It is these forms that are the germs of disease. So that though the germs of putrefaction are everywhere present in the atmosphere, the germs of disease are not necessarily so. We have seen that germs of disease cannot be produced by the germs of putrefaction; they can only proceed from a previous case of disease. Just as an animal cannot be affected with splenic fever unless the splenic-fever bacillus has obtained access to its body, having previously been produced in the fluids or tissues of another animal affected with the same disease, even so we conclude that no person can be affected with scarlet fever unless the germs of scarlet fever (micrococci, as some think) have entered his body, either in the air he has breathed or in some other way; and these germs must have proceeded from the body of a person suffering from scarlet fever. The person so infected will in his turn have the fever germs multiplying in his body, and will disseminate them through the air in the scurf-skin which he casts off during convalescence, probably in the discharge from his throat, and by other channels, and so has obtained power to communicate the disease to any number of other persons. But by no possible combination of unhealthy conditions can scarlet fever be produced from that which is not scarlet fever. So with typhus, typhoid, measles, diphtheria, &c. Typhus only can beget typhus, measles only can beget measles, diphtheria only can beget diphtheria, and so on.

The 'germ theory' thus affords the hope and suggestion of a method of diminishing, if not of getting rid of, such diseases altogether, and to some extent also indicates the direction in which their cure is to be sought. If the particular microbe of each contagious disease were known, the condition of its life and activity understood, and the circumstances inimical to or destructive of its life fully ascertained, there is great probability that this knowledge would at once suggest a method by which its multiplication in the living body could be arrested, and the disease thus cured.

Incidentally this has already happened. It has been pointed out how, in the case of splenic fever, Pasteur diminished the ravages of the disease by inoculating animals with weakened preparations of the organism. It was found that an animal could be made to resist a virulent form of the disease by repeated inoculations of a milder variety, gradually becoming stronger. The animal was thus rendered 'immune', and the process is called 'immunization'. This may be accomplished by injection of the living organism, weakened by some special process, or by injection of small doses of the virulent type, or by injection of the fluid in which the organisms have been cultivated, from which all living organisms have been filtered out. Such methods are now in use for the prevention of typhoid fever and cholera. It was a preparation of this kind, called 'tuberculin', which Koch brought forward in 1890 as a cure for consumption, which unhappily did not fulfil the expectations aroused, though it has proved of immense value otherwise.

Moreover, the blood of an animal rendered 'immune', injected into another animal or a human being, has been shown to be capable of protecting that animal or human being from the disease, even though the animal or person were already infected. The fluid part only, or serum, of the blood of the immunized animal is used. This is the basis of the *serum* or *anti-toxin treatment* of such diseases as blood-poisoning, diphtheria, and plague.

Even without such results, however, the germ theory indicates the means for arresting the spread of contagious diseases and diminishing their occurrence. The means consist in preventing the spread of the germs from an existing case of disease. Too often, however, one case of a contagious disease is simply the breeding-ground of a multitude of other cases, because no steps are taken to prevent the dissemination of the germs. The channels by which the disease may be communicated are various. Emanations from the patient's body, his breath, &c., may contain the disease germs; discharges from bowels and bladder, vomitings, &c., may contain them. If, in a farm, such discharges gain entrance to the well, the water of which is used to wash the milk vessels, the water of the well may be contaminated, and the vessels in turn. The milk probably affords suitable nourishment to the germs of the disease, which multiply in it and are distributed with the milk, thus probably exciting an epidemic of the disease. The term disinfection is used to include all the means adopted to prevent such propagation of disease. It includes separating the diseased person from the healthy, and measures to prevent anything leaving the patient's room until steps have been taken to destroy any germs of the disease that may be about him. Finally, when the disease has terminated, methods are employed to disinfect the bed on which he has lain, the room in which he has been confined, &c., as already noted at the beginning of this article. But what really are entitled to be called disinfectants can only be accurately stated when the microbes of each contagious disease are known, and when the effects on them of the various supposed disinfectants, such as carbolic acid, chlorine gas, Condy's fluid, &c. &c., have been carefully studied. (See such works as Klein's Micro-organisms and Disease; Flügge's Micro-organisms; Griffith's Bacteriology; Sternberg's Manual of Bacteriology, &c.)

GÉRÔME, JEAN LÉON, a French painter, was born on May 11, 1824, at Vesoul. Having come to Paris, he studied under Paul Delaroche in 1841–44, and followed him to Italy, devoting himself with special zeal to the study of the nude. He travelled in the East in various years, visiting Egypt, Arabia, Syria, and Palestine, and deriving thence materials for the exercise of his art. In 1855 the first of his great pictures, the Age of Augustus and the Birth of Christ, appeared, and four years later his picture of the Roman gladiators, Ave Cæsar Morituri te salutant. In 1861 he exhibited his celebrated Phryne before her Judges. In 1863 he was appointed a professor at the École des Beaux-Arts. Many of his pictures have been exhibited in London, and his works are in great favour in England and the United States as well as in his native country. Besides those already mentioned the following are amongst the chief works of Gérôme: Louis XIV. and Molière, Death of Cæsar, The Plague at Marseilles, Rex Tibicen, L'Éminence Grise, and various scenes from Oriental life. He was also an able sculptor. M. Gérôme was decorated with the Prussian order of the Red Eagle and made a commander of the Legion of Honour. He died on Jan. 1, 1904.

GESNERACEÆ, an order of gamopetalous dicotyledons, whose typical genus is *Gesnera*. There

are many species, mostly natives of tropical and sub-tropical regions. They are shrubby herbs, often with tuberous rhizomes, and scarlet, violet, or blue flowers. Some of the genera are frequent in our hothouses, such as *Gloxinia*, *Achimenes*, *Gesnera*, &c.

GEUM, a genus of hardy herbaceous perennials, belonging to the natural order Rosaceæ, chiefly natives of the northern parts of the world. Two of them are common British plants known by the name of avens. *G. canadense*, chocolate-root or blood-root, a North American species, has some reputation as a tonic. A species of saxifrage has *Geum* as its specifie name. See AVENS in SUPP.

GHARDAYA. See GARDAYA.

GHAZNAVIDES. See GHIZNAVIDES.

GHEBERS. See GUEBERS.

GHOORKAS. See GOORKHAS.

GHOST-MOTH, a nocturnal lepidopterous insect (*Hepialus humuli*), so called from the male being of a white colour, and from its habit of hovering with a pendulum-like motion in the twilight over one spot (often in churchyards), where the female, which has gray posterior wings and red-spotted anterior wings, is concealed. The caterpillar feeds on the hop and allied plants, and often does considerable damage to the first-named. It is of a yellowish-white colour, and its body is partially clothed with hairs.

GIALLO ANTICO, the Italian name of a kind of fine yellow marble used in ancient Roman architecture and obtained from Numidia.

GIANT POWDER, a name in America for dynamite.

GIBSON, THOMAS MILNER, English politician, was born at Port of Spain, Trinidad, on Sept. 3, 1806, and died at Algiers on Feb. 25, 1884. He was educated at Walthamstow, where Disraeli was a fellow-pupil, Blackheath, the Charterhouse, and elsewhere, and finally proceeded to Trinity College, Cambridge, where he graduated in 1830. Taking to politics, he was returned in 1837 as Conservative member for Ipswich, but lost his seat on recontesting it as a Liberal. For some years he was unsuccessful in his efforts to again enter the House, but during that time he threw himself with great enthusiasm into the Anti-corn Law campaign. Ultimately, after a keen contest, he was returned for Manchester in 1841, and five years later his great services to Liberalism were rewarded by his appointment as vice-president of the Board of Trade under Lord John Russell. He lost his seat at Manchester in 1857 on account of his opposition to the Crimean War, but later in the same year he was elected by Ashton-under-Lyne. In 1858 Lord Palmerston's government had to resign because of a defeat in the Commons on a vote of censure proposed by Gibson, and subsequently under that premier, and under Lord John Russell, he held the office of president of the Board of Trade from 1859 to 1866. He retired from public life on his defeat at Ashton in 1868.

GIFFORD LECTURES, lectureships endowed by Lord Gifford, one of the judges of the Court of Session, Edinburgh, from 1870 to 1881, who left £80,000 for the purpose. They were founded in connection with the Universities of Edinburgh, Glasgow, Aberdeen, and St. Andrews, and are for the exposition of natural religion in the widest sense of that term, the lecturers to be subjected to no test of any kind, and to belong to any denomination whatever, or to no denomination. The appointments are for two years, but may be held for six. The lecturers are to deliver a yearly course of about twenty original lectures open to all. The first lecturers were: Glasgow, Max Müller; Edinburgh, Hutchison Stirling; St. Andrews, Andrew Lang; and Aberdeen, E. B. Tylor.

GIFU, a town of Japan in Hondo island, about 125 miles W. by S. of Tokio, in a district of the same name. It was nearly completely destroyed by the great earthquake of 1891–92. Pop. (1895), 31,307.

GILBERT, SIR JOHN, R.A., was born at Blackheath in 1817. At first placed in a mercantile house, he soon abandoned business for art, in which he was mainly self-taught. He first exhibited in 1836, and from the start he worked both in water-colour and in oil, being versed, indeed, in all technical matters and methods, and one of the most prolific, facile, versatile, and effective artists of any period. Among his more notable oil-paintings are several illustrative of incidents in Don Quixote, The Education of Gil Blas, Charge of Prince Rupert's Cavalry, The King's Artillery at Marston Moor, Naseby, and a series of pictures of the principal characters in Shakspere. He possesses especial merit in depicting old English scenes. He was the most prominent artist engaged on the Illustrated London News for a number of years after its commencement in 1842, and for a long period produced countless designs for book illustration, such as those for Staunton's Shakspere and Longfellow's Poems. In 1871 he became president of the Society of Painters in Water-Colours, having been elected associate in 1852, and full member in 1855; and on being elected president he was knighted. He became an A.R.A. in 1872, becoming R.A. in 1876. He died on Oct. 5, 1897. In addition to the pictures already named we may mention his Othello before the Senate, Murder of Becket, Wolsey and Buckingham, Entry of Joan of Arc into Orleans, Field of the Cloth of Gold, Crusaders, Doge and Senators of Venice, Fair St. George, The Return of the Victors, Ego et Rex Meus, and Onward. In 1893 he presented a number of his works to the public galleries of London, Manchester, Birmingham, and Liverpool.

GILBERT, WILLIAM SCHWENK, English poet, dramatist, and librettist, was born in London on Nov. 18, 1836. Educated at Ealing and London University, he was from 1857 till 1862 a clerk in the Education Office. In 1864 he was called to the bar, but he has since devoted his time almost exclusively to literature. In 1875 he entered into partnership with Sir Arthur Sullivan the composer, and in conjunction with him produced a series of very clever and enormously successful comic operas: Trial by Jury (1876), H.M.S. Pinafore (1878), The Pirates of Penzance (1880), Patience (1882), Iolanthe (1883), Princess Ida (1884), The Mikado (1885), Ruddigore (1887), The Yeomen of the Guard (1888), The Gondoliers (1889), Utopia, Limited (1893), and The Grand Duke (1896). His other works include Dulcamara, his first dramatic piece (1866); The Palace of Truth (1870), a fairy comedy; Pygmalion and Galatea (1871); The Wicked World (1873); Charity (1874); Broken Hearts (1876); Tom Cobb (1876); The Sorcerer (1877); Dan'l Druce (1878); Gretchen (1879); and The Fortune Hunter (1898). His Bab Ballads (1868) and More Bab Ballads (1872) originally appeared in the periodical Fun. The peculiar, fantastic humour and imaginative power of Mr. Gilbert's work have deservedly gained for it an immense popularity, and have caused the author to be recognized as *facile princeps* in his own sphere.

GILGHIT, or GILGIT, a valley and district in Cashmere state, situated on the southern slope of the Hindu Kúsh, and watered by the Gilgit, or Ysam, a tributary of the Indus. See CASHMERE.

GILL, a measure of capacity equal to ¼ of a pint, or $\frac{1}{32}$ of a gallon.

GILLS, the respiratory organs of animals which respire by obtaining oxygen from water, as crustaceans, molluscs, fishes, and amphibians. In fishes they consist of cartilaginous or bony arches attached to the bones of the head, and furnished on the exterior convex side with a multitude of fleshy leaves or fringed vascular fibrils resembling plumes, and of a red colour in a healthy state. The water is admitted by the gill-opening, and acts upon the blood as it circulates in the fibrils. See ICHTHYOLOGY, AMPHIBIA.

GILLYFLOWER, a name bestowed on such cruciferous flowers as the wall-flower or carnation, &c. The clove-pink (*Dianthus Caryophyllus*) is termed clove gillyflower, though this is, strictly speaking, a tautological name, for gillyflower is derived from the French *girofle*, clove.

GINGELLY OIL. See BENNÉ OIL in SUPP.

GIRARDIN, ÉMILE DE, French journalist and politician, was born in Paris on June 22, 1806, and died there on April 27, 1881. He was an illegitimate son of the Count Alexandre de Girardin and Madame Dupuy, and for the first twenty-one years of his life bore the name of Delamothe. His earliest literary efforts were the novels Émile (1827) and Au Hasard (1828), partly based on his own experiences. He was connected as projector, editor, or otherwise with a number of newspapers and periodicals, the most successful being La Presse, a Conservative organ established in 1836. A controversy in its columns led to a duel between Girardin and Armand Carrel, which proved fatal to the latter. In politics Girardin played many parts. He was elected to the Chamber in 1834, but his parliamentary influence was small. He was fined 5000 francs in 1867 for attacks on the imperial government in La Liberté. He wrote numerous political pamphlets, and a few pieces for the stage. For his wife see GIRARDIN in body of book.

GIRGEH, a town, formerly the capital of Upper Egypt, on the left bank of the Nile. It possesses a Roman Catholic convent, the oldest in Egypt. Pop. 10,000.

GLADSTONE, WILLIAM EWART, statesman, orator, writer, was born at Liverpool on the 29th of December, 1809, the birth year of Tennyson and several other eminent men. He was of Scottish descent on both sides. His father, John Gladstone, a wealthy Liverpool merchant, afterwards a member of parliament and a baronet, was a native of Leith, and belonged to a Lanarkshire family that can be traced back for not a few centuries; while his mother, Anne Robertson, belonged to the north of Scotland, her father having at one time been provost of Dingwall. William Ewart, their third son, was sent, like his brothers, to Eton (in 1821), where, without being specially distinguished, he took a good position on the score of scholarship and personal character, and began his literary career as a regular contributor to the Eton Miscellany. One of his chief Eton friends was Arthur Henry Hallam, for whom Tennyson's In Memoriam forms such a noble poetic monument. He remained at the school for about six years, afterwards read for some time with private tutors, and in 1828 entered Christ Church, Oxford. Here his studies were regular and systematic, and at Michaelmas, 1831, he took his degree with first-class honours in both classics and mathematics. At this time his views were decidedly Conservative and High Church, and it was natural that as a prominent member of the Oxford Union debating society he should give them free vent. He left Oxford in the spring of 1832, and paid a six months' visit to Italy, where he acquired a command of the Italian language, and also was enabled to gratify his artistic tastes. His political career began in 1833, when he was returned to parliament as Conservative member for Newark, a borough then almost entirely under the influence of the Newcastle family, notwithstanding the passing of the Reform Act. One of the earliest of his speeches in the House was delivered on the 3rd June, 1833, when, in a debate on the abolition of slavery in the West Indies, he made an eloquent defence against what was practically an attack on the management of his father's estates in Demerara. He did not express himself as hostile to emancipation, but as against over-hasty measures, and he demanded that the interests of the planters should be duly regarded. It was natural that such a man as Mr. Gladstone should not remain a mere private member, and accordingly we find him appointed a minor lord of the treasury, and subsequently under-secretary for the colonies in Sir Robert Peel's administration of 1834–35. He was able to strengthen the hands of his colleagues in several debates in which he took part, and in that which preceded the fall of the ministry, namely, on the question of dealing with the revenues of the Irish Church, he delivered an eloquent address on the government side. Mr. Gladstone, of course, went out of office with his chief, to whom he was warmly attached, and for whom he entertained a profound admiration. For several years he had now a less prominent position in public affairs. In 1838, while he was suffering from an affection of the eyes, he made a tour in the south of Europe. Previous to this journey he had written a work entitled The State in its Relations with the Church, which was published in his absence, and of which a fourth edition, revised and enlarged, came out in 1841 (two vols.). The writer endeavours to prove that it is the duty of the State as such to give an active and exclusive support to the established religion of the country, because, among other reasons, 'the government stands with us in a paternal relation to the people, and is bound in all things to consider not merely their existing tastes, but the capabilities and ways of their improvement'. In criticising this work in the Edinburgh Review, in an article which led to a friendly interchange of letters between the two parties, Macaulay characterized the author as 'the rising hope' of the 'stern and unbending Tories'. During his residence in Italy Mr. Gladstone made the ascent of Mount Etna, and also witnessed one of its eruptions. On his return in the following year he married, in July, 1839, Catherine, daughter of Sir Stephen Glynne, Bart., of Hawarden Castle, Flintshire. In 1841 the Whig ministry of Lord Melbourne came to an end, and Peel returned to power. Mr. Gladstone, who was still member for Newark, was now appointed vice-president of the Board of Trade and master of the mint, and was also sworn a member of the privy-council. In 1842 great fiscal reforms were inaugurated, some of which are understood to have been due to Mr. Gladstone, whose knowledge of questions of this kind was already beginning to be widely known, and whose opinions were now turning more and more in the direction of free-trade. In 1843 he was raised to the presidency of the Board of Trade (being also a member of the cabinet), and as one of the measures proposed by him at this time we may mention the abolition of restrictions on the export of machinery, while next year he carried a railway bill establishing cheap or 'parliamentary' trains. He opposed the proposal to reduce the duty on foreign sugar, however, on the

ground that the reduction would be against the interests of Britain's West Indian and other colonies. In the beginning of 1845 he resigned office on account of the resolution of the cabinet to remodel and increase the Maynooth grant, a measure which he held it would be inconsistent on his part to support considering his published views regarding the relations of church and state. But by the time that the bill for the better endowment of Maynooth had actually been brought in by the government (April, 1845), Mr. Gladstone had reconsidered the question, and now found that he could give the bill his hearty support, 'believing the measure to be conformable to justice, and not finding any principle on which to resist it'. He was out of office only for a short period, having accepted, in the end of 1845, the post of colonial secretary, which had been vacated by Lord Stanley owing to his opposition to Peel's changed views regarding the corn-laws. Mr. Gladstone was now also quite at one with Peel in regard to the repeal of the corn-laws, and feeling that in the circumstances he could hardly continue to represent Newark as practically the nominee of the Duke of Newcastle, he resigned his seat. The result was that though he had an important place in the cabinet, he was without a seat in the House of Commons, and was therefore unable to give his colleagues assistance that would have been of the utmost value to them in carrying their much-contested measure. It was not till 1847 that he again became a member of the House, being then returned as one of the representatives of Oxford University, and still as a Tory, or rather as a Peelite, the name applied to a certain number of politicians forming a party by themselves at this period. Among measures that about this time received his support were the bills for the removal of the Jewish disabilities and the repeal of the navigation laws.

In the winter of 1850 51 Mr. Gladstone paid a visit to Naples, and was so impressed by the cruelty and tyranny of the Neapolitan government, of which he had fully convinced himself by visits to the prisons and by careful inquiries, that on his return he issued one or two letters denouncing the atrocities. The charges which he made produced a profound sensation both at home and abroad, and being brought before the notice of parliament, Lord Palmerston, then foreign minister, warmly commended the course Mr. Gladstone had taken. One important result was that English sympathy was strongly excited in favour of Garibaldi and the Italian patriots, and that the moral and material support of Britain contributed in no small degree to the overthrow of the Italian Bourbons and the establishment of a united Italy.

By this period of his career Mr. Gladstone had begun to display remarkable ability as a financier, and in 1852 he made a damaging attack upon the budget brought in by Mr. Disraeli as chancellor of exchequer under Lord Derby. The Derby ministry was defeated and resigned, and on the formation of the coalition ministry of Lord Aberdeen, Mr. Gladstone became chancellor of the exchequer. At this time it was not very clear whether he was to be classed as a Liberal or as a Conservative; many of the latter party had certainly no longer any wish to claim him. His first budget was laid before the House on 18th April, 1853, and for five hours the members sat listening not only in silence, but with profound attention and unmistakable pleasure. This was a peace budget, but next year he had to provide for the expenses of the Crimean war. Lord Aberdeen resigned office in January, 1855, and Lord Palmerston succeeded him. Mr. Gladstone again became chancellor of the exchequer; but when the premier consented to a committee of inquiry into the conduct of the late administration, he at once resigned, regarding this measure as an implied censure upon his late colleagues. He remained out of office for rather more than four years, during which his former friends, the Conservatives, repeatedly received his support, as in regard to the divorce bill and other measures; and he joined in the vote of censure (on the Conspiracy to Murder Bill) which drove Lord Palmerston from office in 1858. In this year he visited Corfu as commissioner extraordinary to the Ionian Islands, which were then under British protection but were agitating for union with the kingdom of Greece, and he had to report to the home government that such was the wish of the people. His Studies on Homer and the Homeric Age not inappropriately appeared at this time.

In 1859 Mr. Gladstone took office under Palmerston as chancellor of the exchequer, and may thus be said to have finally cast in his lot with the Liberal party. He now carried out various reforms in the national system of taxation, and produced a series of budgets as interesting as fairy tales and as satisfactory in their results as they were interesting. One of his earliest measures was the abolition of the excise duty on paper, which was practically a tax on literature and an obstruction to popular education; another was the conclusion of the commercial treaty with France, already negotiated, a measure equally beneficial to both countries. During the American Civil War his sympathies were on the side of the South; but though many of his admirers regretted this, others among them had their feelings inclining in the same direction. At the general election of 1865, owing to his views regarding the Irish Church, he lost his seat for Oxford University, which he had represented continuously since 1847; but he was forthwith returned with great enthusiasm by South Lancashire. In October, Lord Palmerston died, and Earl Russell came into power with Mr. Gladstone as leader of the House of Commons and chancellor of the exchequer. He now joined with Mr. Bright in order to carry a new reform bill, but this step led to the secession of a small section of the Liberal party ('the Adullamites', or 'the cave'), and to the defeat of the government, which was succeeded by that of Lord Derby in 1866. Next year the Conservatives passed a reform bill establishing household suffrage in the boroughs, but to the final shape which the measure assumed Mr. Gladstone and Mr. Bright materially contributed. In 1866 he succeeded in carrying against the Conservative government his resolutions in favour of the disestablishment of the Irish Church, with large majorities on his side. His Irish Church suspensory bill was similarly carried, but in view of the approaching general election the House of Lords threw it out. By this time Lord Derby had resigned in favour of Mr. Disraeli, who also resigned after a very brief tenure of office.

The general election on the extended franchise took place towards the end of 1868. The result was a great triumph for Mr. Gladstone, who was now the recognized leader of the Liberal party. His former constituency, indeed, rejected him, but he was returned for Greenwich, and in the new house the Liberals were in a majority of 120. He at once became prime minister, and the next six years are undoubtedly the most brilliant in his whole career, while at the same time a most memorable period in the history of the country. In 1869 he carried his bill for the disestablishment of the Irish Church, and next year a highly important land-act for Ireland. Among other measures passed in this parliament may be mentioned the

establishment of the national systems of elementary education in England and Scotland, the introduction of voting by ballot, the abolition of purchase in the army (by a somewhat arbitrary use of the prerogative of the crown), besides acts dealing with bankruptcy, public health, mines, university tests, &c. In 1873 his University Bill for Ireland was defeated, as it failed to satisfy either Protestants or Roman Catholics, and Mr. Gladstone resigned. Mr. Disraeli, however, would not undertake the task of forming a ministry, and he had to resume the reins of power. But the by-elections were now beginning to go decidedly against the government, and when in January 1874 Mr. Gladstone appealed to the country, the result was that Mr. Disraeli became premier in his stead.

He now formally resigned the leadership of the Liberal party, and was succeeded in this position by the Marquis of Hartington (now Duke of Devonshire). For a time he ceased to be prominent in public affairs, and devoted more of his attention to literary, historical, and ecclesiastical matters, two pamphlets on the Vatican decrees coming from his pen. The eternal Eastern Question brought him once more to the front, and in 1876 he published a pamphlet in denunciation of the Bulgarian 'horrors', and proposing the expulsion of the Turks from Europe 'bag and baggage'. This manifesto undoubtedly weakened the position of the government, a result to which his attacks on the Anglo-Turkish treaty and the Afghan war also contributed. At the end of 1879, the time for the election of a new parliament being now almost at hand, he entered upon what has generally been known as the (first) 'Midlothian Campaign', an astonishing exhibition of eloquence and vigour, intended to stir up his numerous supporters in Scotland to lend their aid in ousting the Conservatives from office. Parliament was dissolved at the end of March, Mr. Gladstone was triumphantly returned for Midlothian, and for a second time became premier with a handsome majority on his side, being also for two years chancellor of the exchequer.

Ireland first claimed the attention of the new government, and a second land-act was soon passed by Mr. Gladstone, under which fixity of tenure, fair rents, and free sale were secured for the Irish tenant-farmers. Since the establishment of the Land League, however, and under the movement for Home Rule led by Mr. Parnell, that country had got into a most disturbed state, and strong repressive measures were deemed necessary. A Crimes Bill and an Arms Bill were accordingly passed, and Mr. Parnell was arrested and lodged in Kilmainham jail with several of his supporters. In the spring of 1882 he was released, apparently on the understanding that he would give some aid in putting down outrages. This arrangement with the Home-Rule leader, scoffingly designated by opponents as the 'Kilmainham treaty', at once led to the resignation of the lord-lieutenant and the Irish secretary, Mr. Forster. Then followed the Phœnix Park tragedy—the murder of the new chief secretary, Lord Frederick Cavendish, and the under-secretary, Mr. Burke—to which the government responded with a Crimes Bill and an Arrears of Rent Bill, the former meeting with the most determined resistance on the part of the Irish members, now past-masters in the art of parliamentary obstruction. Abroad the government had to deal with affairs of great difficulty in Egypt and the Soudan and also in South Africa, and some of the settlements arrived at did not greatly redound to their credit. The fate that overtook Gordon damage with the electorate. In 1884 the question of parliamentary reform was again taken up, and on 28th February Mr. Gladstone expounded his new measure in a speech of great power and lucidity. Both parties in the state were now practically agreed that the time for reform had again come, and the bill for extension of household suffrage to the counties passed in the end of the year, and the redistribution bill early in the following year under Lord Salisbury, Mr. Gladstone having by this time resigned office when defeated on an amendment to his budget proposals.

The general election of 1885 took place under the new electoral arrangements, and when the pollings closed it was found that Mr. Gladstone's followers were exactly equal in number to the Conservatives and the Parnellites combined, the latter now forming a compact body of eighty-six. Thus the electors had not effectively responded to his appeal for such a majority as would make the Liberal party independent of the Irish vote. By the end of the year statements were published to the effect that Mr. Gladstone's views on Home Rule had undergone a change, and that he was now prepared to surrender to Mr. Parnell's demands, and grant to Ireland a parliament of her own. The majority of his supporters and admirers were slow to believe this, but all doubt was set at rest when, having succeeded Lord Salisbury as premier, he brought forward in parliament (in April, 1886) a scheme for the government of Ireland on Home Rule lines, combined with a plan for buying out the Irish landlords. The bill being defeated, the government naturally resigned, and on an appeal to the country the Conservatives returned to power under Lord Salisbury, who had now on his side a majority of more than a hundred. Mr. Gladstone's proposals had thus been emphatically condemned, many of his oldest and most influential supporters had turned against him, and the old Liberal party had been broken up. His personal relations with Mr. Parnell now became rather close, but the disgraceful figure cut by the latter in the divorce court naturally put an end to this, his re-election as leader of the Irish party having drawn from Mr. Gladstone the statement that notwithstanding the splendid services rendered to his country by the Irish leader, 'his continuance at the present moment in the leadership would be productive of consequences in the highest degree disastrous to the cause of Ireland'. Mr. Parnell's animus towards him from this time was well marked, but 'the uncrowned king' was now shorn of most of his dominions and his reign speedily came to an end. In 1892, after another Midlothian campaign, and his re-election by a greatly reduced majority, Mr. Gladstone became premier for the fourth time, the Irish question being now 'the sole link that bound him to public life'. In parliament his majority consisted of only about forty—taking Liberals and Parnellites together—and thus his party was entirely dependent on the latter. Next year he brought in another Home Rule Bill which differed considerably from the previous one. It was forced through the House of Commons, largely by the heroic exertions of Mr. Gladstone himself, but was rejected in the House of Lords by an overwhelming majority. By this time age had begun to tell even upon his wonderful vitality. His memory, his eyesight, and his hearing were not what they had been, and in 1894 he resigned office and practically retired from public life, being succeeded in the premiership by Lord Rosebery. He retained his seat for Midlothian, however, till the general election of 1895, which proved

last speech as premier was on the Lords' amendments to the Parish Councils Bill, which drew from him the declaration that the amending power of the peers ought not to be allowed to continue. His closing years were chiefly devoted to literary pursuits, though he both spoke and wrote in denunciation of the atrocities perpetrated by the Turks on the Armenians, and advocated the cause of the Cretans and Greeks as against the Turks. Latterly he was attacked by a cancerous growth in the nasal region, and the national sympathy was warmly expressed on his behalf. He bore his sufferings with fortitude, and after vainly seeking relief abroad for his malady, returned home to die. On May 19, 1898, he peacefully expired at Hawarden Castle, long his favourite residence. In accordance with the universal sentiment of the nation he was buried at Westminster Abbey. He was survived by his wife, and by three sons and three daughters. His eldest son, William Henry, after being a member of parliament and lord of the treasury, died in 1891, leaving a boy to inherit the Hawarden property. His youngest son, Herbert, has been well known as a Liberal representative of Leeds, and as holding various subordinate posts in different governments.

Of Mr. Gladstone's political career different estimates will be formed by different persons; regarding his moral and intellectual eminence, there can be but little difference of opinion. Though specially great as an orator, a financier, and a parliamentary leader, his mental powers were such that he might have made a foremost position for himself in any walk of life; and it is not absolutely certain that politics was the sphere best suited for the exercise of his extraordinary gifts, though from his birth and early surroundings it was natural that he should adopt a political career. That he was fond of power and of popular applause is doubtless true; but he was not ambitious in the lower sense of the word, and cared nothing for titles or for the influence that wealth bestows. Tyranny and oppression found in him a fiery opponent, but his imagination was perhaps too easily heated. He was somewhat deficient in the knowledge of men, and along with this may be mentioned a corresponding deficiency in the sense of humour. Earnestness, and a severe and lofty morality, were the most pronounced features of his character; and theological speculation and biblical and ecclesiastical studies were naturally congenial to him. Though his intellectual and moral sympathies were wide his mind was receptive rather than creative, and neither his spoken nor his written words have added much to the world's stock of fruitful ideas. He wrote extensively on a variety of topics, and his books, including collections of speeches, magazine articles, &c., are rather numerous. His Rome and the Newest Fashions in Religion (1875) sets forth his views on Vaticanism; his Gleanings of Past Years (seven vols., 1879) comprise a number of papers in which ecclesiastical topics bulk largely; his matured views on Ireland are given in Special Aspects of the Irish Question (1892). His Homeric studies belong chiefly to the middle period of his life, and, besides the work already mentioned, include Juventus Mundi: the Gods and Men of the Heroic Age (1869); and Homeric Synchronism: an Inquiry into the Time and Place of Homer (1876); with a Primer of Homer, and a little book entitled Landmarks of Homeric Study. Homer he regarded as the autnor of both Iliad and Odyssey. To the closing period of his life belong The Impregnable Rock of Holy Scripture, a work in support of the orthodox view of the Mosaic writings; verse translations of Horace's Odes; The Psalter, with a Concordance; and an annotated edition of Bishop Butler's Works, with a volume of Studies Subsidiary to the Works of Bishop Butler (1896). Various lives of Mr. Gladstone have been published, among which may be mentioned those by T. Archer, G. Barnett Smith, Sir T. Wemyss Reid, and Herbert Paul. A full biography, based on Mr. Gladstone's papers and other materials, has been prepared by Mr. John Morley (three vols., 1903).

GLAISHER, James, aëronaut and meteorologist, was born in London on April 7, 1809 In 1829 he was appointed to the Ordnance Survey of Ireland, and from 1833 till 1836 he was on the staff of the Cambridge Observatory. In 1836 he became assistant in the astronomical department of Greenwich Observatory, and four years later he was chosen first superintendent of the magnetical and meteorological department, a post which he held till his retirement in 1874. From the year 1841 he prepared the registrar-general's meteorological reports. He was elected fellow of the Royal Society in 1849, and he assisted in founding the Royal Meteorological Society. He made a large number of balloon ascents, and in September, 1863, along with Mr. Coxwell, he reached a height of about 37,000 feet, the highest ascent on record. He wrote and translated many works on astronomy, meteorology, and ballooning (Travels in the Air, for instance). He died on Feb. 7, 1903.

GLANCE-COAL. See Anthracite.

GLAUCOMA, in medicine, an almost incurable disease of the eye, in which the eyeball becomes of stony hardness by the accumulation of fluid within, and the consequent increase of pressure causes disorganization of all the tissues. Loss of sight is sometimes very rapid. It is called also *Glaucosis*.

GLOBE-FISH. See Plectognathi.

GLOBE-FLOWER, a popular name of *Trollius europœus*, belonging to the natural order Ranunculaceæ, a common European plant in mountainous regions, having deeply five-lobed serrated leaves and round pale-yellow blossoms, the sepals of which are large and conspicuous, while the petals are very small. It is often cultivated in gardens, and is common in mountain pastures in the north of England, north of Ireland, Wales, and Scotland.

GLOBIGERINA, one of the Foraminifera (which see), a microscopic animal having a many-celled shell found fossil in the chalk and tertiary formations, and still so abundant in our seas that its shells after death form vast calcareous deposits of mud or ooze known as 'globigerina ooze'.

GLOVERSVILLE, a city of the United States, in Fulton county, New York, on a branch of the Mohawk river, 44 miles north-west of Albany. By far the most important industry is the manufacture of gloves, whence the town has received its name. Pop. (1890), 13,864; (1900), 18,349.

GLOXINIA, a small genus of plants, of the natural order Gesneraceæ, distinguished by the corolla approaching to bell-shaped, the upper lip being shortest and two-lobed, the lower three-lobed, with the middle lobe largest, and also by the summit of the style being rounded and hollowed. The species are natives of tropical South America, whence they were introduced into Britain early in the eighteenth century. They are now among the greatest ornaments of European hothouses, owing to their richly-coloured leaves and their ample, graceful, delicately-tinted flowers. The chief species is *G.* (*Ligeria*) *speciosa*, a Brazilian plant with large violet flowers, from which many fine varieties have been derived. The various cultivated varieties are usually included under the specific name *G. hybrida*.

GLYPTODON (Gr. *glyptos*, engraved, and *odous*, tooth—so named from its fluted teeth), a gigantic fossil edentate animal, closely allied to the armadilloes, found in the upper tertiary strata of South America. It was of the size of an ox, and was protected by a coat of mail formed of polygonal osseous plates united by sutures.

GNAPHALIUM, a genus of widely-spread composite plants having their foliage usually covered with a white woolly down, and their flower-heads of the 'everlasting' kind, some of them natives of Britain. *G. Leontopodium* is the *edelweiss* of the Alps. See EDELWEISS in SUPP.

GNEIST, HEINRICH RUDOLF HERMANN FRIEDRICH, German jurist, was born at Berlin on August 13, 1816, and studied at the university there, in which, in 1844, he became professor-extraordinary, and in 1858 ordinary professor of jurisprudence. He took part in politics as a member of the Prussian House of Deputies, and of the diet of the German Empire, ranging himself on the liberal side. He wrote extensively on law, constitutional history, &c., and had a specially thorough knowledge of English constitutional history. He was ennobled in 1888, and died on July 21, 1895. The following are his chief works: Adel und Ritterschaft in England (1853); Das heutige Englische Verfassungs- und Verwaltungsrecht (1857–63); Englische Verfassungsgeschichte (1882, History of the English Constitution, Eng. trans.); Das Englische Parlament (1886, History of the English Parliament, Eng. trans.); &c.

GOALANDA, a river mart and municipality of Bengal, at the confluence of the main streams of the Ganges and Brahmaputra. It is the terminus of the East Bengal Railway, and the starting-point for the Assam steamers. Within a very few years it has developed a very large trade, but its buildings are liable to be swept away by the July floods of the rivers. Pop. 8652.

GOAT'S-BEARD, the general name of plants of the genus *Tragopogon*, belonging to the order Compositæ, herbaceous perennials, chiefly natives of Europe. The seeds have long beaks and feathery appendages; hence the name. The leaves are narrow, the upper being shorter than the lower, and the florets are all ligulate and perfect. The yellow goat's-beard (*T. pratensis*), greater goat's-beard (*T. major*), and purple goat's-beard (*T. porrifolius*) are found in Britain. The latter species is commonly cultivated for its root as a culinary vegetable, under the title of *salsify*.

GOAT'S-THORN, a name given to two hardy evergreen papilionaceous plants of the genus *Astragalus*, *A. Tragacantha* (great goat's-thorn) and *A. Poterium* (small goat's-thorn). The former, long cultivated in Britain, is a native of the south of Europe, the latter of the Levant. See TRAGACANTH.

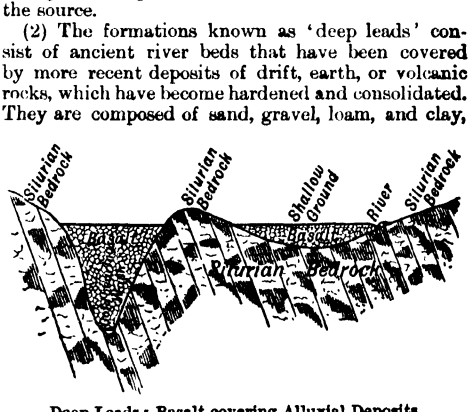
GOGO, a town in Bombay Presidency, in Ahmadabad district, on the peninsula of Kathiawar, on the Gulf of Cambay, 55 miles north-west of Surat. Formerly a great cotton centre, it has of late years been superseded by Bhaunagar, 8 miles nearer the plantations. Pop. (1891), 6638.

GOLDEN ROSE, in the Roman Catholic church an ornament of gold consecrated by the pope on the fourth Sunday of Lent. It was originally a single flower of wrought gold, coloured red; afterwards the golden petals were decked with rubies and other gems; finally the form adopted was that of a thorny branch, with several flowers and leaves, and one principal flower at the top, all of pure gold. It is sent to some favoured prince, some eminent church, or distinguished personage.

GOLD MINING. *Occurrence of the Metal.*—Gold is usually found in nature in the metallic or native state, and may be distinguished from iron and copper pyrites and other yellow metallic minerals by its malleability and softness. Native gold is never pure. Its quality varies from about 800 to 950 fine, or about 20 to 23 carats (see GOLD). Electrum is a native alloy of silver and gold about 500 fine. A native amalgam with mercury also occurs. The metal sometimes occurs crystallized in octahedra and other cubic forms. It is also found in irregular masses, which may be nodular, filiform, or arborescent, or it may form thin leaves merely gilding the surfaces of the rock. More commonly it exists in grains irregularly distributed through sand, gravel, or rock. These grains are sometimes so minute as to be invisible to the naked eye, and the presence of gold can only be detected by subjecting the rock to a careful assay, either by grinding with mercury, washing, or fire assay.

The metal occurs in (1) alluvial deposits, or 'placers'. These are deposits of gravel, sand, clay, or loam, consisting of the debris of weathered rocks, generally transported by running water from hillsides to valleys and plains. They mark and follow the courses of existing rivers or of rivers belonging to former ages. Gold is found in them in all degrees of coarseness, from minute specks or 'colours' to masses weighing many ounces. One of these, designated the 'Welcome Stranger', found at Dunolly in Victoria, weighed 2195 ozs. Troy, and many others of large weight have been found. These larger masses have usually a more or less rugged and lumpy exterior, and are described as 'nuggets'. The largest usually occur near the source from which the gold in the alluvium has been derived. This source almost always consists of veins of quartz, or other material, occurring in one of the older rocks. Alluvial deposits vary in character from pipe-clay to coarse gravel. The gravel is usually loose, but sometimes in working the deposits intervening layers are met with which are cemented together. These are known as 'false bottoms'. River sands also frequently contain gold. Alluvial deposits are often very rich, particularly in 'nuggets'. This is largely due to the force of the water carrying forward the light earthy material, while the larger and heavier particles, owing to their greater resistance, accumulate nearer the source.

(2) The formations known as 'deep leads' consist of ancient river beds that have been covered by more recent deposits of drift, earth, or volcanic rocks, which have become hardened and consolidated. They are composed of sand, gravel, loam, and clay,



Deep Leads: Basalt covering Alluvial Deposits which occupy Bottoms of Troughs.

the so-called 'wash dirt' or 'pay dirt' varying from a few inches to several feet in thickness. Formerly these 'deep leads' were the main drainage channels of the country, and in rain-storms were heavily flooded, carrying the débris from the hillsides down

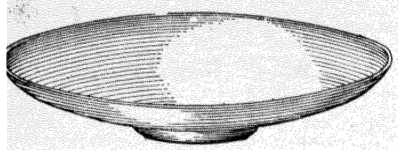


Fig. 1. Gold-washing Pan.

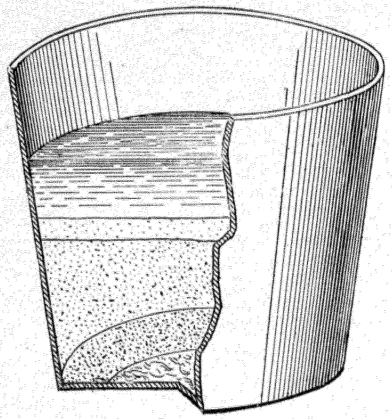


Fig. 2. Tossing Tub.

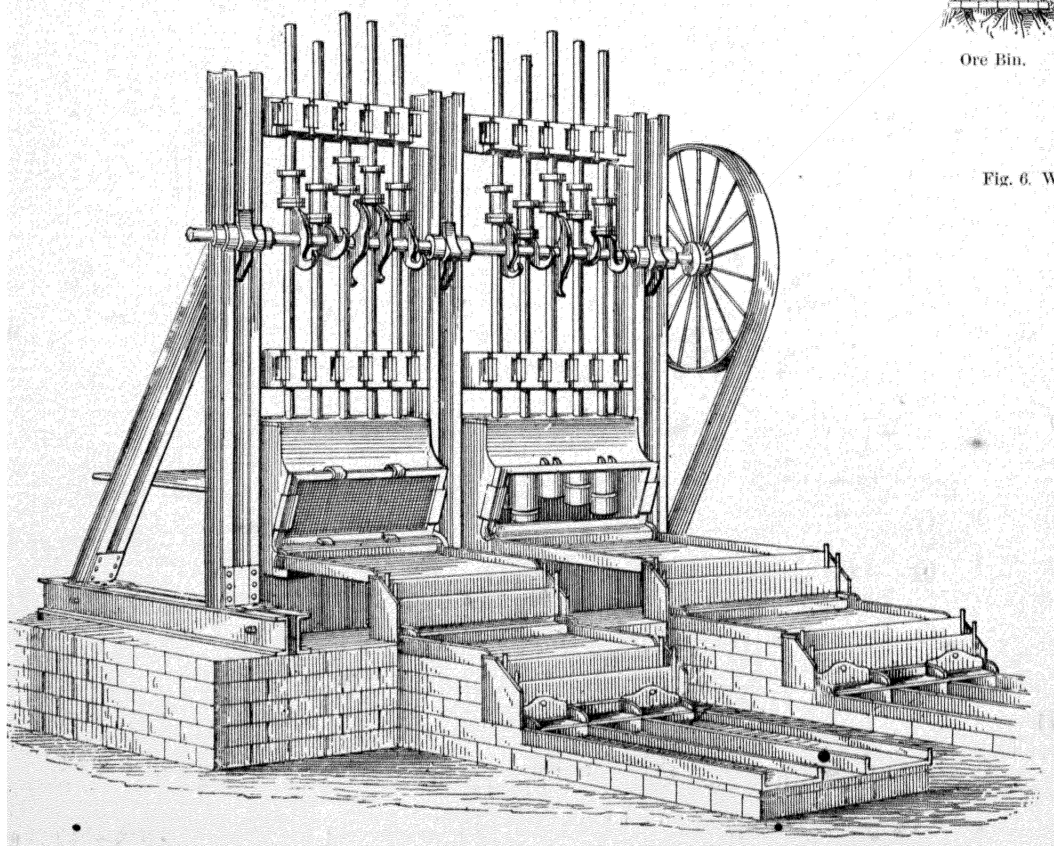


Fig. 4. 10-head Stamp Battery.

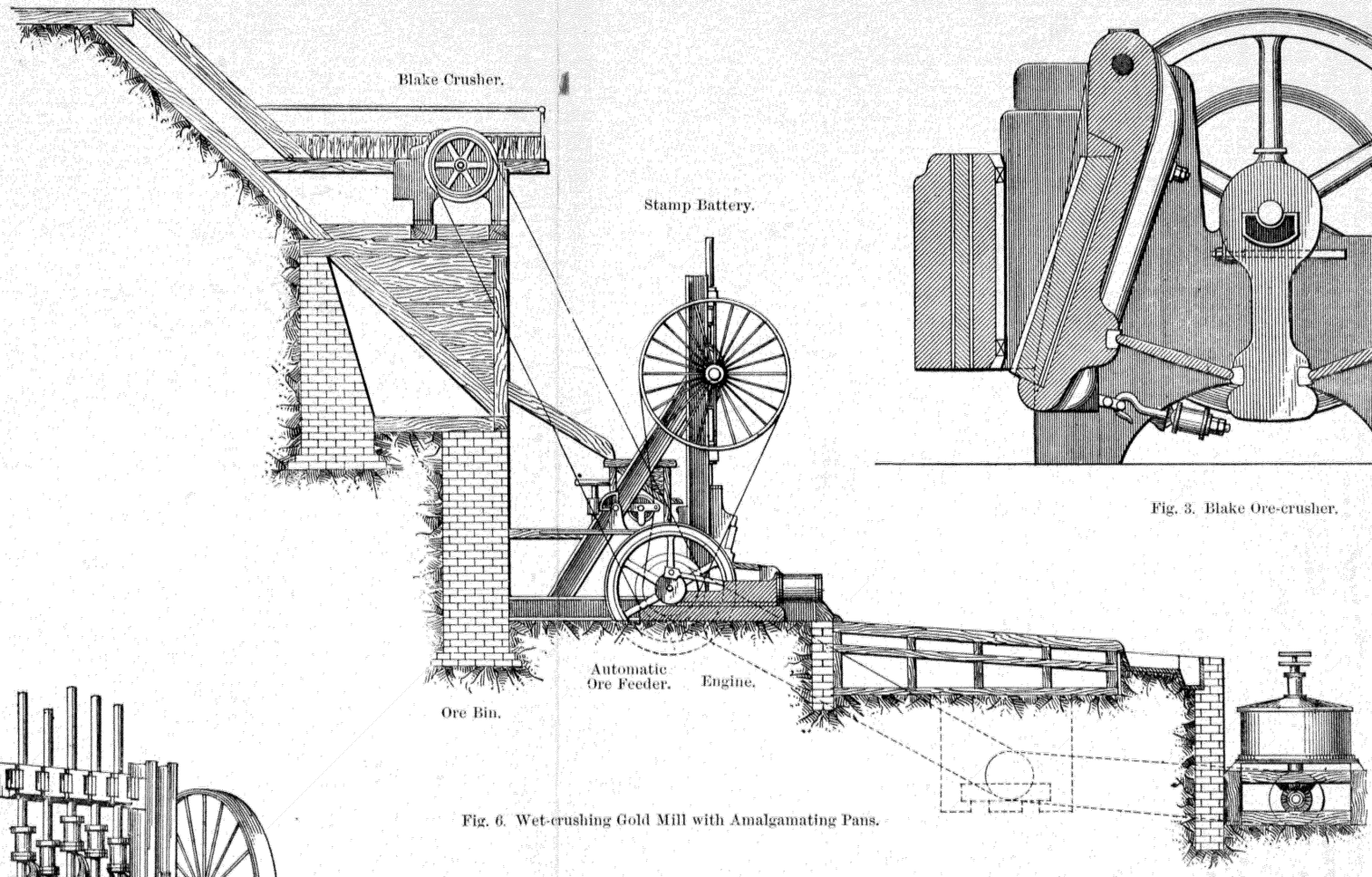


Fig. 6. Wet-crushing Gold Mill with Amalgamating Pans.

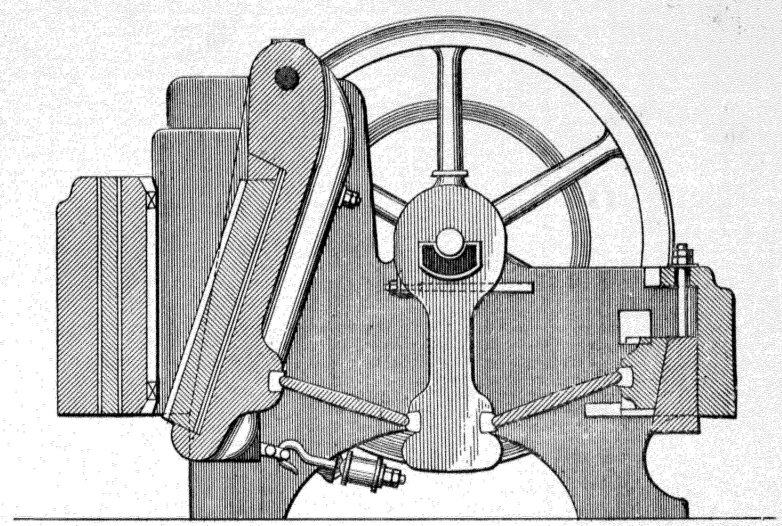


Fig. 3. Blake Ore-crusher.

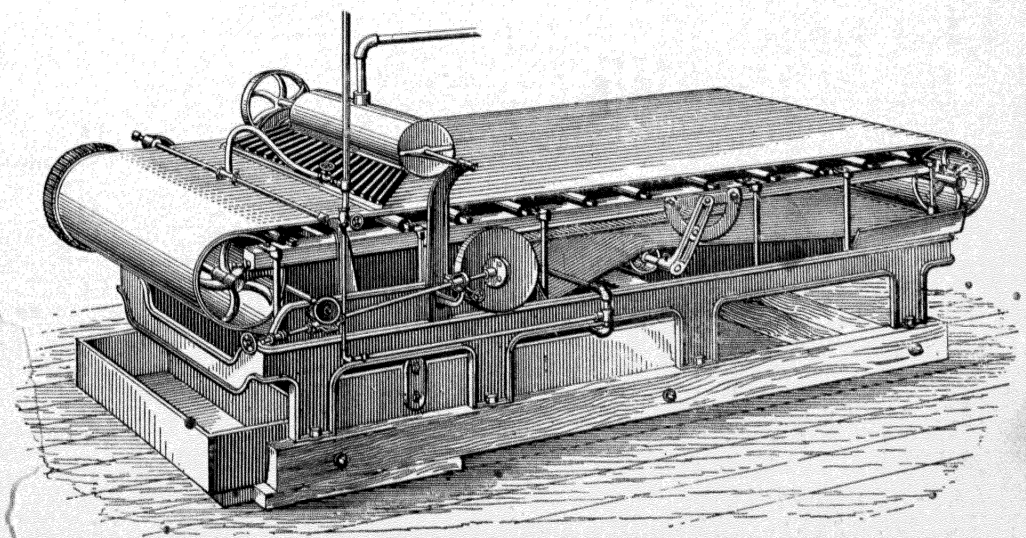


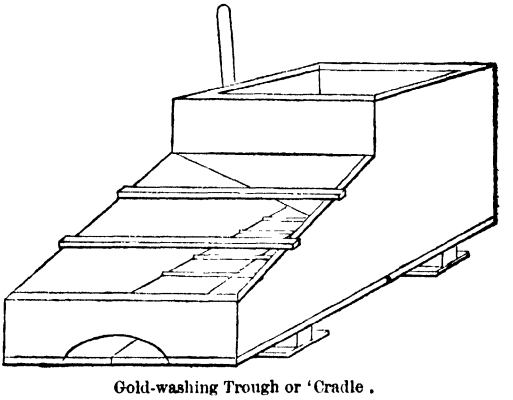
Fig. 5. Frue Vanner.

the creeks and gullies. In Victoria the deep leads are often overlaid with a deposit of basalt known as 'bluestone', showing volcanic action to have been instrumental in covering up the deposit. (See fig. on p. 466.) These deposits often extend out beyond the covered portion, and in mining operations trouble is occasioned by water which finds its way in through the exposed portion. Their direction is traced by boring.

(3) In the primitive rocks gold occurs generally, though not invariably, in veins of quartz. The terms 'lodes', 'reefs', 'ledges', are also used much in the same sense as veins. The metal is not uniformly disseminated through the rock, but occurs in most cases in rich streaks and pockets. Careful examination will often reveal its presence, but no general appearance of the quartz can be relied on. Highly mineralized quartz is generally most productive. The minerals usually present are silver, zinc, lead, copper, iron, nickel, bismuth, tellurium, and manganese-bearing minerals, the commonest being iron pyrites, mispickel, zinc blende, galena, copper pyrites, argentite and other silver ores, nagyagite and other tellurides, bismuthine, antimonite, and arsenide of manganese. Sometimes these—especially iron pyrites—are present in very large quantities. Near the surface this has been completely decomposed and partially converted into oxide of iron, conferring a reddish-brown colour on the more or less spongy rock. Such decomposed rocks containing much oxide of iron are described as 'gossans'. In the cavities small particles of free gold can often be observed. In the unaltered portions of the rock the accompanying minerals may be plainly distinguished. The veins may be compact and large, but the mineral streak often occupies only a portion of the lode, although many 'leaders' may occur. Much of the lode is sometimes barren. In some quartz deposits the stone is uniformly rich; in others the gold is concentrated at certain points in what are known as pockets. According to a recent report from Cripple Creek, Colorado, a mass weighing over a hundredweight with a slight admixture of quartz has been found there. A similar mass of less size was found some years ago in India, and another near Sydney, N.S.W., was 5 feet high, 1 foot wide, and 6 inches thick, full of threads, wires, lumps, and sheets of gold. It realized £15,000. The 'banket' ore of South Africa resembles both alluvial deposits and reefs. It consists of a mass of quartz fragments mostly irregular, embedded in a cement of mineralized matter which carries the gold. This, near the surface, is completely 'weathered', and an incrustation of oxide of iron remains surrounding the quartz. Strangely enough this deposit resembles a reef rather than an alluvium, and extends to great depths. Several 'deep' mines are now in operation. No satisfactory explanation can be given of this formation. Ores of other metals frequently contain gold. Iron and copper pyrites, antimonite, galena, and silver ores are often gold-bearing. The precious metal is extracted in the smelting of the mineral. Gold occurs also in combination with tellurium and possibly with selenium, as well as in the free state. Most telluric ores are gold-bearing, and the presence of this element is often looked upon as an indication of gold.

Working Alluvial Deposits. Placer Mining.—When the alluvium is at the surface the exploration of the ground can proceed forthwith, and with pick and shovel the gravel is turned over and the nuggets taken out. The remainder is afterwards washed to recover the finer particles of gold, in the pan, the dolly, or the cradle. When the 'pay dirt' is covered with soil, &c., the 'cover' is first removed to lay it bare, and the washing proceeded with. From the above references the presence of water is a most important item in the satisfactory exploiting of alluvium. The washing of sands and gravels is a simple matter. In washing in the pan—'panning out'—a quantity of the dirt free from stones is put into a shallow iron or wooden dish some 15 inches in diameter (Plate I., fig. 1), with a slight depression in the middle. It is then mixed with water, and the dish put with its edge just under water with one side a trifle lower than the other. Any lumps are broken up by hand. By a gentle whirling and jerking motion the sand and other light bodies are washed over the edge of the pan, and the heavy matters containing the gold remain at the bottom and accumulate in the central depression. Pebbles are thrown out, and the 'colours' (specks of gold) are then sought after and picked out, or the whole heavy residue saved, dried, and blown, or treated with a little mercury to extract the gold.

The 'dolly' or 'tossing tub' (Plate I., fig. 2) is intended for washing fine stuff or coarsely-crushed material passing through a sieve having twelve meshes to the linear inch. It consists of a circular tub, in which the dirt is mixed with sufficient water, and is stirred round with a shovel or other implement some 3 or 4 minutes. A little of the water is then removed, and the tub struck on its sides for some few minutes with a hammer to quicken the subsidence of the heavy matters. The water is then poured off with the lightest matters, and the upper portions of the remaining mud scraped off and thrown aside. Some fresh dirt is added and the operation repeated. By this means a gradual accumulation of gold takes place at the bottom of the tub—or *kieve*, as it is called—and is removed from time to time. Some tossing tubs are provided with rotary stirrers.



Gold-washing Trough or 'Cradle'.

The 'cradle' consists of a short box or trough 6 or 7 feet long, mounted on a kind of rockers, and slightly inclined to allow the mud to run off. A box, with a bottom of iron plate perforated with ½-inch holes, is placed over the higher end of the trough. Underneath this an inclined plate directs the stuff to the top of the trough, across the bottom of which strips of wood called *riffles*, about half an inch thick, are fixed transversely to arrest the heavy particles of gold. The 'pay dirt' is thrown into the box at the top, and water is led into or poured upon it. The finer portion is thus carried through the holes into the trough. Lumps are broken up,

and the cradle rocked from side to side with a jerking motion. The light matters are carried away by the water from the lower end of the trough, and the particles of gold and other heavy matters lodge behind the bars and are afterwards collected.

Sluicing. — This is the method adopted where practicable for treating alluvial deposits. The 'sluices' consist of troughs called 'flumes', in sections about 12 feet long, mounted on trestles to give a sufficient inclination—from ¾ to 1½ inch to the foot. (See Plate II., fig. 2.) The lower ends of the troughs fit into the upper ends of the succeeding sections. The bottom of the sluice-box is crossed transversely by bars of wood or iron. In long sluices these are about 2 inches thick, and are supported by longitudinal bars, dividing the bottom of the sluice into rectangular spaces. The gravel is placed at the top and washed down by a stream of water, while the lumps in hand-sluices are broken up by raking.

The smallest of the sluices, known as the 'long tom', and worked by two or three men, consists of two such sections. Into the upper one the gravel is thrown, and the lower end is closed by an iron grid set at an angle, to keep back the pebbles and large stones, while the sand, &c., passes through to the lower trough. In this it deposits its gold and heavy matters behind the riffle bars, which in these shorter sluices are not so thick. The longer sluices, for dealing with larger quantities of material at a time, are made 250 feet long, or longer in many cases, and if there are many stones in the stuff to be treated, the sluice is divided into two sections, placed at different levels. The lower end of the upper section is not blocked, but near it the bottom consists of an iron grating—the 'grizzly'. The stones are washed forward over the grating, and fall or are raked out at the end. Under the grating is the second section of the sluice, often arranged at right angles, or to run in an opposite direction and with a smaller inclination. On this the sand and fine particles carried by the water fall, so that the smaller particles of gold may be recovered. In sluicing, mercury is often fed in at the top of the sluice in order to amalgamate the gold, and the amalgam then lodges behind the riffles. In other cases the fine sand, after passing through the first section of the sluice, falls on inclined tables covered with blankets, rough cloth, or hides with the hairy side up, over which it flows in a thin stream. These 'blanket-strakes' serve to arrest and recover the fine gold. (See Plate II., fig. 3.) Amalgamated copper plates are employed for the same purpose in some cases, over which the fine sand flows before running to waste.

In dealing with the hard 'cements' and 'deep leads', the material is generally first treated in a 'puddling' machine. (See Plate II., fig. 1.) In this the pay dirt is disintegrated by edge-runners, or revolving rakes or harrows, or some other form of crushing or stirring apparatus, while a current of water carries the débris from the machine into the flumes and over the strakes. Much of the coarse gold remains in the puddling machine. Where the configuration of the ground admits, there is no difficulty in getting the necessary fall, but where the surface is level this has to be obtained artificially, by erecting very high poppet-heads over the shafts from which the pay dirt is drawn. In some cases these are over 100 feet in height, the puddlers being placed on a platform at a suitable elevation, from which the flumes slant downwards, being carried on trestles.

Hydraulic Mining.—In places where the ground is suitable, these deep leads and other alluvial deposits are worked by washing down the gravel by means of a powerful jet of water, a head of 200 to 250 feet being sometimes employed. The jet is delivered from a movable pivoted nozzle—the 'monitor' or 'giant'—against the bank of auriferous material, and the detached débris washed into sluices where the gold is deposited. These sluices are larger than those already mentioned, being sometimes 5 to 6 feet in width, 2 to 3 feet deep, and are often paved with stone, and provided with iron riffle bars. Some of them are upwards of a mile long. Mercury is always fed in at the top, and the amalgam recovered by raising the riffle bars after turning off the water and cleaning out the gravel. An immense water supply is required for this purpose, and the water is often brought for miles in 'flumes', which cross gulches and valleys supported on trestles, and are carried in tunnels through hills. This is the cheapest mode of working. From 2 to 4 grains of gold per ton, and in some few cases less, is sufficient to pay expenses. If the material is exceptionally hard, blasting is resorted to in order to break it down, when the action of the jet is sufficient to disintegrate it. A 'miner's inch' of water is the quantity that will flow through a hole an inch square, in an inch board under a head usually of 7 inches, but more or less according to the locality, the time of flow being specified. A 24-hour inch at 7 inches pressure is nearly 14,000 gallons. In other cases an inch reaches 17,000 gallons. The river gravels of Scotland, Ireland, and Wales, and many parts of Europe, have yielded gold, but the richest of such deposits are those of California, Klondyke, and Australia. Magnetic iron sand, tin stone, ilmenite, sulphides, garnets, and diamonds are often associated with alluvial gold.

Quartz Mining.—In dealing with the material from veins or reefs of quartz and other hard substances containing free gold, the stuff is reduced to fine powder and then passed, suspended in water, over copper plates amalgamated with mercury, to which the gold adheres. The 'tailings' are then treated either by 'concentration' and the concentrates chlorinated, or the whole of the tailings is treated by the cyanide process. The ore to be crushed is first passed through a 'stone breaker' or 'ore crusher'. In the Blake type (Plate I., fig. 3) the moving jaw permits the introduction of the larger lumps at the top, but only allows the crushed material to pass out at the bottom in pieces a little larger than walnuts. In the Gates type a gyrating cone revolves inside a fixed vertical cone. Both have ribbed surfaces, and they are of different angles, so that the large material introduced at the top is broken down before it can pass out at the bottom. The broken ore passes to the ore bins, thence to the feeders and on to the stamps, or some form of grinding-mill. Plate I., fig. 4 shows an ordinary gravitation stamp battery, with the screen in front removed. The lower part of the battery consists of a cast-iron box—'mortar-box'—fitted on one or both sides with a fine screen of wire-cloth or perforated sheet metal. At the bottom of this box is a row of iron blocks called 'dies', upon which the stamps fall. The stamps are heavy cylindrical cast-iron blocks—heads—to which are attached loose steel facing pieces—'shoes'—fixed to the lower ends of the vertical iron rods—stems—moving up and down between guides carried by the framing. The stamps are raised by cams keyed on the revolving shaft. These engage with collars—tappets—fixed on the stems. As the shaft revolves, the cam raises the stamp twice in each revolution and allows it to fall when the cam passes. The stamps are thus kept pounding away at the ore in the mortar-box.

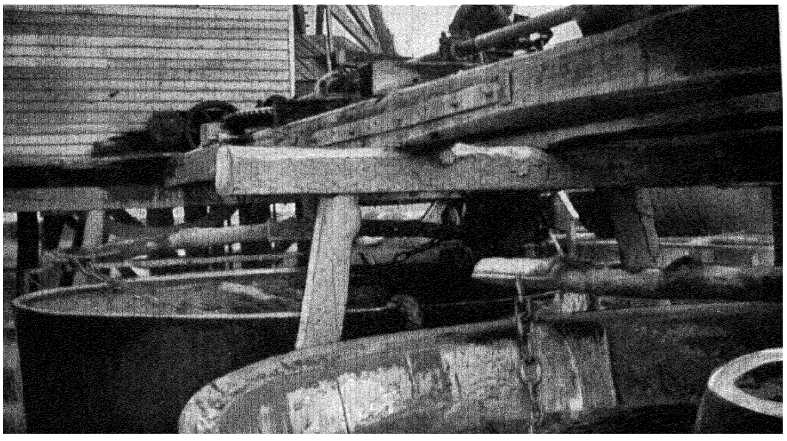


Fig. 1. Puddling Machines, in which the "wash-dirt", containing gold, is stirred round and round until the gold is freed from the dirt, and sinks by gravitation to the bottom.

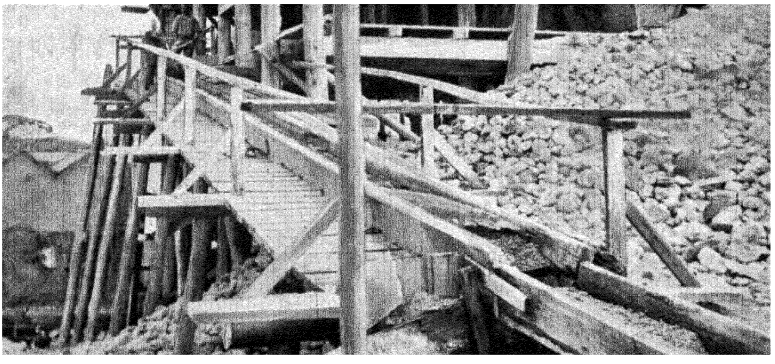


Fig. 2. Flumes from the Puddlers which catch all coarse gold.

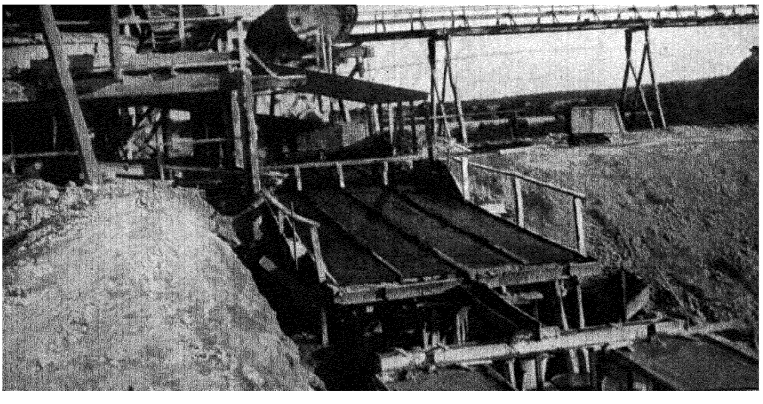


Fig. 3. Blanket Strakes which collect the bulk of the fine gold.

[From photographs, by courtesy of West Australian Gold Fields, Ltd.]

The heads and their attachments weigh up to nearly 10 cwts., and make from 70 to 90 blows per minute. Five heads usually constitute a battery. Some mines have 200 stamps at work. Each head should crush about 1½ to 2 tons of ore per day. The motive power may be steam-engines or turbines. Some mills are driven electrically. In wet crushing-mills a stream of water is admitted to the mortar-box, and carries the crushed material through the screens. Mercury is fed into the mortar-boxes in small quantities, and much of the gold is retained there on amalgamated copper plates. Slightly inclined amalgamated copper plates arranged in steps are placed in front of the battery, and over these the crushed ore pulp passes slowly as it leaves the mortar-box, the gold being retained by the amalgamated surfaces. The plate nearest the battery is generally heavily silver-plated. The 'tailings' which may still contain some gold are treated as described below. The stamp battery is often replaced by roller-crushing machines and grinding-mills of various types, the objects of which are the same; and with certain ores these are even more effective. The best known of these are Krom Rolls and the Huntingdon Mill. Steam stamps are also employed, making up to 200 blows per minute.

Treatment of Amalgam.—The amalgam, both that which is retained on plates placed in the battery and that which accumulates on the plates outside, is collected from time to time. The plate just outside on which the splash from the battery falls, is made small so as to be readily removable for cleaning up. The other plates are not so often disturbed. The amalgam is ground with water in a small iron pan with a revolving muller—'clean-up pan'—to cleanse the amalgam from sand, &c. Afterwards it is pressed in wash-leather, canvas, or other material to expel the excess of mercury, which is returned to the battery as required. The residue is 'retorted', that is, it is heated in retorts to expel the mercury, which is condensed and recovered. The gold obtained is subsequently melted in crucibles and afterwards refined. 'Free-milling' ores yield nearly the whole of their gold by this treatment. Ores containing sulphides, arsenides, antimony, tellurium, &c., do not, and are described as 'refractory ores'. Free-milling ores are generally 'weathered', the minerals having been decomposed by the action of the atmosphere and water.

Treatment of Tailings.—Tailings always contain gold, either as 'float' gold, 'rusty' gold, or bound up in pyrites or other mineral occurring in the rock. Pulp (that is, the crushed rock) containing float gold is led through amalgamating pans, where it is ground with mercury before running to waste. In dealing with pyritical ores, when chlorination or grinding with mercury is resorted to, the pulp is passed to concentrating appliances, blanket strakes and 'vanners' being employed. Vanners (Plate I., fig. 5) are by far the most effective and generally employed. Each consists of a slightly sloping table, formed of an endless travelling belt of india-rubber, which is stretched over rollers at the ends of a frame, and so mounted as to be capable of violent agitation while moving slowly in an upward direction. The vibrations number 200 a minute. The pulp is led on at the higher end, and the flow of the water carries the light matters down the slope, the separation being greatly assisted by the shaking movement. The residue is also sprayed with water, and the heavy matters only are carried forward by the belt over the higher end, and pass into a box below, being then known as 'concentrates'. These may be ground for a prolonged period with mercury (old-fashioned), or treated by chlorination. For cyanide treatment, concentration is unnecessary. Plate I., fig. 6 shows the arrangement of a gold mill dealing with free-milling ores.

Chlorination Processes.—The concentrates are first calcined to remove the sulphur and arsenic, and to render the material more porous. The residue is treated in vats provided with false bottoms and with filter-beds, or other suitable receptacles, having tightly-fitting covers. The calcined ore, as free as possible from 'slimes'—very fine material which becomes impervious when wetted—is damped with water and sifted into the vats, in order that it may lie lightly. The cover is put on and luted, but a plug in the top taken out. Chlorine gas is admitted slowly under the false bottom of the vat through a pipe for that purpose, and gradually lifts out the air. The plug is then inserted, and the chlorine allowed to act for some 30 to 40 hours, fresh supplies of the gas being added if found necessary. The vat is then ventilated, the cover removed, and the ore treated with water several times to dissolve the chloride of gold that has been formed. The solution drains through the filter-bed, and passes out into the settling tank, where any sand, &c., is deposited. From the settlers it passes to the precipitating tanks, where a solution of sulphate of iron—ferrous sulphate—or other precipitant is added, and the whole thoroughly paddled or mixed by mechanical stirrers. The gold is thus precipitated as a brownish-purple powder, which is allowed to settle, and the liquor is then syphoned off. Several batches of solution are thus treated, and the gold obtained is collected, washed with acid, dried, and melted in crucibles. Many modifications of the original process with special forms of plant have been introduced. In the Newberry-Vautin process air is pumped into the chlorinating vessel to increase the pressure; in the Pollok process hydraulic pressure and rotation are employed; and Mears works under pressure of chlorine. In several of these modifications the chlorine is generated in the chlorinating vessel by means of bleaching-powder, and either sulphuric acid or acid sulphate of soda. Various precipitants have also been employed. See GOLD.

Cyanide Process.—In this process, which is also known as the MacArthur-Forrest process, the whole of the tailings are treated with a weak solution of cyanide of potassium—or soda—containing about from 0·5 to 1 per cent of the salt. The treatment is extremely simple. The tailings, free from slimes, are placed in huge vats with false bottoms and filter-beds, and the cyanide solution run in. It is allowed to act for 10 to 20 hours or more, and then kept circulating by means of pumps. In about 2½ to 3 days the exhaustion is complete. The solution is then passed through troughs or boxes, in which are placed baskets filled with zinc shavings. These troughs are divided by stops into compartments which communicate with each other at the top and bottom alternately, so that the liquid flows up and down through successive compartments. The gold is deposited as a black powder on the zinc, and is recovered by shaking the baskets in clear water, thus detaching the gold, and by cleaning out the mud at the bottom of the boxes. It is melted, strongly heated to volatilize the zinc, and treated with nitre, &c., to oxidize and slag off as much impurity as possible. The bullion obtained is very impure, and the slags, which contain a good deal of gold, are sold to refiners, who smelt them with lead, which is afterwards cupelled. The liquids from the boxes are re-used, and, after determining the amount of cyanide they contain, returned to the tanks and

made up to strength. The cost of the process is so small that very poor tailings pay for treatment. It can under favourable conditions be reduced to 1*s.* 6*d.* per ton. Refractory ores can also be treated direct, and with tailings there is no need for concentration. Some telluric ores yield their gold by this treatment. In dealing with certain classes of ore much cyanide is lost. Antimonial ores and those containing much copper pyrites and white-iron pyrites and zinc sulphide consume most. The pyrites oxidize, and the cyanide is decomposed by the soluble matters formed. Free acid also decomposes the cyanide. Lime is added to neutralize it. Sulman uses cyanogen bromide in place of cyanide. In the electrical process of deposition the gold is deposited on lead plates, which occupy the boxes and form the negative electrode. These are insulated from the boxes which form the positive electrode. The bullion obtained is of course purer.

Pyritic Smelting.—This term is applied to a method of smelting pyritic gold ores in cupolas, with or without the addition of coke. If the ore contains above 40 per cent of sulphur no coke is necessary. On charging the ore into the cupola some of the sulphur is driven off by the heat, and part of the remainder when it reaches the twyers burns and furnishes sufficient heat to melt the regulus—a sulphide—and slag off the ferrous oxide resulting, and the quartz. A plentiful supply of air is required. The gold remains in the regulus, which also contains any copper present.

Gold Refining and Parting.—The crude bullion is dealt with according to its purity. Very base bullion is cupelled with lead, only the silver and gold remaining on the cupel. When less impure it is melted in crucibles, and nitre and borax added to oxidize and flux the copper and other metals it contains. After this treatment the bullion still contains silver as well as small quantities of other metals, to separate which the gold is 'parted'. This is effected by boiling the alloy in acids to dissolve out the silver, but unless a sufficient quantity of silver is present the acid will not completely dissolve it. The gold is first alloyed with the necessary quantity of silver. For nitric acid parting the alloy contains 2½ to 3 times as much silver as gold. When sulphuric acid is employed it contains 4 times as much or more. The alloy is granulated by pouring the molten metal into water, and the granulated metal is then boiled with nitric acid in glass or platinum vessels, whereby the silver is converted into silver nitrate and dissolved, the gold remaining unattacked. After drawing off the solution the residue is washed, dried, and melted down. The silver in the solution is afterwards recovered by precipitating it with hydrochloric acid as chloride, which is subsequently reduced to metal. At the same time the nitric acid is recovered. Sulphuric acid is often used in place of nitric, particularly in dealing with silver containing a little gold. The granulated metal is first boiled with sulphuric acid in iron pans, suitably provided with covers to carry off the vapours for the recovery of the acid. This converts the silver into soluble sulphate of silver. After a second treatment the residue is washed, dried, and melted down. The silver is recovered from the sulphate by treatment with ferrous sulphate or other reducing agent, or by passing the solution over metallic copper, by which it is precipitated. The precipitated silver is afterwards washed and melted down. When little silver is present it may be removed by melting the gold in a crucible and bubbling chlorine gas through the molten metal by means of a clay tube passing through a hole in the cover. The silver is converted into chloride, which melts and rises to the top of the metal. The gold is not chloridized, the temperature being sufficient to completely decompose its chloride. The scum contains some gold, and this is afterwards recovered. Besides removing the silver, any traces of lead, antimony, bismuth, tellurium, or other base metals which would render the metal brittle are converted into chlorides and volatilized, so that the metal is left tough and malleable. The process is often employed to toughen brittle gold. The employment of bichloride of mercury by gold-beaters to toughen the gold used for that purpose produces a similar effect, the chloride of mercury giving up half its chlorine for the purpose, and being volatilized as calomel. Platinum is separated from gold by alloying with so much silver as to reduce the platinum below 9 per cent. The alloy is then parted by nitric acid, when the platinum dissolves out with the silver. Osm-iridium, a hard alloy, which often occurs with alluvial gold, is removed from the metal before parting by allowing it to subside to the bottom of the pot after addition of silver. This it does owing to its being heavier than gold.

GOMEL, a town of European Russia in the government of Mogilev, on the right bank of the Sosch. It is an important railway junction, and has a trade in timber, hemp, and linseed. Pop. (1897), 41,231.

GOMUTI PALM. See GOMMUTI PALM.

GONDA, chief town of a district of the same name in the Fyzabad division of Oudh, India, 28 miles N.N.W. of Fyzabad. Pop. (1891), 17,423. The district has an area of 2880 sq. miles. Pop. (1891), 1,459,229.

GOODALL, EDWARD, line-engraver, was born at Leeds on Sept. 17, 1795. He was self-taught, and early in his career attracted the notice of Turner, a number of whose pictures he engraved, including the large plates of Tivoli and Cologne, and various plates in the England and Wales and Southern Coast series. He also engraved many plates for the Annuals, and the largest number of the landscapes after Turner that illustrate the elegant editions of Rogers' Italy and Poems. He engraved a number of plates for the Art Journal, several from pictures by his son, Frederick Goodall, R.A., of which the Cranmer at the Traitors' Gate and the Happy Days of Charles I., both of large size, are the most important. He died in London on April 11, 1870.

GOODALL, FREDERICK, R.A., English painter, son of Edward Goodall, the engraver (see above article), was born in London on Sept. 17, 1822. At seventeen years of age he began to exhibit, and he has produced pictures very varied in subject and generally of high excellence. He was elected A.R.A. in 1853, and R.A. in 1863. Exemplifying variety, the following may be named: Raising the Maypole in the Olden Time (1851), Cranmer at the Traitors' Gate (1856), The Opium Bazaar, Cairo (1863), Mater Purissima and Mater Dolorosa (1868), The Subsiding of the Nile (1873), The Holy Mother and Child (1876), The Flight into Egypt, and A New Light of the Harem (1884), Andromeda (1887), The Pets of the Harem (1889), The Thames from Windsor Castle (1890), Isles of Loch Lomond (1891), Spinners and Weavers (1892), The Waters of the Nile (1893), and The Palm Grove (1894). Latterly his subjects were mostly from Oriental life and scenery and from Holy Writ. He also painted many portraits. He died in London On July 28, 1904.

GOOD HOPE, CAPE OF. See CAPE OF GOOD HOPE.

GOOD TEMPLARS, a temperance society which combines the principles of teetotalism with certain mystic rites, imitated less or more from freemasonry,

having secret signs, passwords, and insignia peculiar to itself. It originated in New York in 1851, and extended to Britain in 1868. The organization consists of local 'subordinate' lodges, county 'district' lodges, national 'grand' lodges, and an international 'right worthy' grand lodge. A 'juvenile order' is also attached, and the Templars have founded an orphanage at Sunbury, near London, at a cost of £10,000. See TEMPERANCE SOCIETIES.

GOOSEGRASS. See CLEAVERS in SUPP.

GORTSCHAKOFF, ALEXANDER MICHAELOVITCH, Russian diplomatist, cousin of the general of the same name, was born at St. Petersburg on July 16, 1798, and died at Baden-Baden on Mar. 1, 1883. He entered the diplomatic service in 1824 as secretary to the Russian embassy in London. His experience in diplomacy was extended in Vienna, Florence, Stuttgart, &c., and he showed considerable dexterity in securing the neutrality of Austria during the Crimean war. In 1856 he became minister of foreign affairs, and in 1862 chancellor of the empire, having by that time made himself one of the foremost diplomatists of Europe. He was a prominent member of the Berlin Congress, 1878, but his influence was then on the decline, and in 1882 he was superseded by M. de Giers.

GORUCKPORE. See GORAKHPUR.

GOSCHEN, GEORGE JOACHIM, VISCOUNT, politician and financier, of German extraction, was born in London on Aug. 10, 1831, and educated at Rugby and Oriel College, Oxford, where he graduated B.A. with first-class honours in classics in 1853. He then became a partner in the firm of Frühling and Goschen, but not long after he took to political life and entered parliament in 1863 as M.P. in the Liberal interest for the City of London. In 1865 he was sworn of the privy-council on accepting the office of vice-president of the Board of Trade in the Russell ministry, and in the following year he became chancellor of the Duchy of Lancaster with a seat in the Cabinet. He went out of office with his colleagues a few months afterwards, but on Mr. Gladstone's accession to power in 1868 he became president of the Poor Law Board, subsequently succeeding Mr. Childers in 1871 as first lord of the admiralty. In conjunction with M. Joubert he proceeded to Egypt in 1876 on behalf of the bondholders to reorganize the finances of that country, and two years afterwards he represented Great Britain at the international monetary conference held in Paris. During 1880–81 he was at Constantinople on a special mission whose object was to compel Turkey to fulfil some at least of her obligations to Greece under the Berlin Treaty of 1878, and in this case his negotiations were highly successful. On several occasions he found himself unable to move with the Liberal party; and when in 1886 Mr. Gladstone launched his Home Rule scheme for Ireland, Goschen became one of the leaders of the Liberal-Unionists. In 1887 he succeeded Lord R. Churchill as chancellor of the exchequer under Lord Salisbury, and in 1895 he again took office under the same leader as first lord of the admiralty. From this office he retired towards the end of 1900, and was soon after raised to the peerage as Viscount Goschen. He was appointed an Ecclesiastical Commissioner in 1882, and he has also been Lord Rector of Aberdeen (1887) and Edinburgh (1890) Universities. His most important political achievement was the carrying in 1888 of his scheme for the gradual reduction of the National Debt. From 1880, when he retired from the representation of the City of London, till 1885 he sat for Ripon, during the next year for East Edinburgh, and from 1887 he represented the St. George's Hanover Square division of the Metropolis. He is author of several financial and political pamphlets, and of a well-known work on the Theory of Foreign Exchanges (1864).

GOSSE, EDMUND WILLIAM, literary critic and poet, was born in London on Sept. 21, 1849, his father being Philip H. Gosse, the naturalist. After a private education in Devonshire he was appointed Assistant Librarian to the British Museum in 1867, from which he was transferred in 1875 to the Board of Trade as translator. He has travelled in Norway, Sweden, Denmark, and Holland, and in 1884–85 he was engaged on a lecturing tour in the United States. He has been Clark Lecturer on English Literature in Trinity College, Cambridge, and in 1885 that university conferred on him the honorary degree of M.A. Mr. Gosse has made a special study of Scandinavian literature, and has published Studies in the Literature of Northern Europe (1879), consisting of essays on Scandinavian, Dutch, and German literature. Many of his books are on English literature, as, for instance, Life of Gray (1882, in the English Men of Letters series); Seventeenth Century Studies: a Contribution to the History of English Poetry (1883); From Shakespeare to Pope: an Inquiry into the Causes of the Rise of Classical Poetry in England (1885); Life of Congreve (1888); History of Eighteenth Century Literature (1890); Life of Philip Henry Gosse, naturalist (1890); Gossip in a Library (1891); Questions at Issue (1893); The Jacobean Poets (1894); Critical Kit-Kats (1896); History of Modern English Literature (1897); and Life and Letters of Dr. Donne (1899). He has also written a romance entitled The Secret of Narcisse (1892), and several volumes of poems: Madrigals, Songs and Sonnets (1870); On Viol and Flute (1873); King Erik (1876), a tragedy; The Unknown Lover, a drama (1878); New Poems (1879); Firdausi in Exile and other Poems (1886); In Russet and Silver (1894); and Collected Poems (1896).

GOSSE, PHILIP HENRY, naturalist, was born at Worcester on April 6, 1810, and died on Aug. 23, 1888. He was brought up at Poole and received his education there and at Blandford. From 1827 to 1835 he was resident in Newfoundland, and afterwards travelled through Canada and the United States, making all the time large collections of insects, &c. In 1844 he visited Jamaica. Among his many works are: The Canadian Naturalist (1840); The Birds of Jamaica (1851); A Naturalist's Sojourn in Jamaica (1851); The Aquarium (1854); Marine Zoology (1855–56); Actinologia Britannica (1860); Romance of Natural History (1860–62); &c., besides many contributions to the learned societies. The later years of his life were spent at St. Marychurch, a quiet Devonshire village, and whilst there he carried out his extremely valuable investigations of marine organisms. His Actinologia Britannica is a standard work on the sea-anemones. His Life has been written by his son Edmund (see above).

GOULD, JOHN, ornithologist, was born at Lyme Regis, Dorsetshire, on Sept. 14, 1804, and died at London on Feb. 3, 1881. Originally a gardener, he was appointed taxidermist to the Zoological Society's Museum in 1827, and henceforward his whole life was devoted to the study of birds. His chief works —all magnificently illustrated—are: A Century of Birds from the Himalayan Mountains (1831); The Birds of Europe (five vols. folio, 1832–37); The Birds of Australia (seven vols. folio, 1840–48, with three supplementary volumes, 1850–52); The Birds of Great Britain (five vols., 1862–73, &c.); besides a number of monographs on the humming-birds, the trogons, &c. Part of his enormous collection was

secured for the British Museum, and the rest is now in Philadelphia.

GOUNOD, CHARLES FRANÇOIS, French operatic composer, was born at Paris on June 17, 1818. After graduating at the Lycée St. Louis he studied at the Conservatoire under Halévy, Lesueur, and Pauer, and afterwards in Italy. His visit to Italy exercised a very powerful influence over the tendencies of his art, and on his return he for a time studied for the priesthood. This idea, however, he soon abandoned, and after a period of silence he produced a Messe Solennelle in G at London in 1851. In 1859 he produced his opera Faust, which raised him to a high rank among composers. Other operas followed, among which are Philémon et Baucis (1860), La Reine de Saba (1862), Mireille (1864), Romeo et Juliette (1867), Cinq Mars (1877), and Polyeucte (1878). The war drove him to London, where he resided several years. He wrote also a motet Gallia, and other choral works and songs; the oratorios Redemption (1882), Mors et Vita (1885), and a Mass for the Jeanne D'Arc festival (1887). He died at St. Cloud on Oct. 18, 1893 Gounod's operas are characterized rather by excellent lyrical passages than by skilful handling of the dramatic portions. His Faust remains his greatest and most popular work. In 1880 he was created a grand officer of the Legion of Honour. See Mad. M. A. de Bovet's Charles Gounod, his Life and Works (1891).

GOURA. See PIGEONS.

GOURD-TREE. See CALABASH-TREE.

GOUROCK, a town of Scotland in Renfrewshire, on the Firth of Clyde 2 miles west of Greenock. It is a popular summer residence, and is an important place in connection with the Clyde passenger traffic. It has near it a prehistoric monolith called Granny Kempoch, which has witch associations. Pop. in 1891, 4475; in 1901, 5224.

GOUT-WEED. See BISHOP-WEED in SUPP.

GRAHAM, SIR GERALD, English general, was born on June 27, 1831, in Cumberland, and educated at private schools in Britain and Germany. After a training in the Royal Military Academy at Woolwich he received a commission as second lieutenant in the Royal Engineers in 1850, and became captain in 1858, major in 1859, lieutenant-colonel in 1861, colonel in 1869, major-general in 1881, and lieutenant-general in 1884 He served with great distinction in the Crimean War, during which he was present at the battles of Alma and Inkerman, frequently did duty in the trenches, and took part in the attacks on Sebastopol, and was twice wounded. His services were recognized by several honours, including the Victoria Cross, the 5th class of the Turkish Medjidieh, and a knighthood of the Legion of Honour, the first being conferred for his gallantry in heading a ladder-party at the assault on the Redan, and for other heroic acts. In the China campaign of 1860 he was present at the capture of the Taku forts and of Peking, and in the Egyptian war of 1882 he rendered brilliant service as commander of a brigade, especially at Kassassin, where he had the general command, and at Tel-el-Kebir. In 1884, after Baker Pasha's defeat, he was in command of an expedition to the Eastern Soudan, during which he fought the battles of El-Teb and Tamai; and in 1885 he commanded the expedition sent out to Suakim after the fall of Khartoum. He was created K.C.B. in 1882, G.C.M.G. in 1885, and G.C.B. in 1896. He died at Bideford, Devonshire, on Dec. 17, 1899. See his Life, Letters, and Diaries (1901), edited by Col. R. H. Vetch.

GRAINS OF PARADISE, Guinea grains or Malaguetta pepper, the pungent somewhat aromatic seeds of *Amomum Melegruetta*, belonging to the natural order Zingiberaceæ, a plant of tropical Western Africa. They are chiefly used in cattle medicines and to give a fiery pungency to cordials. The 'Grain Coast' of Africa takes its name from the production of these seeds in that region.

GRAM, the chick-pea (*Cicer arietinum*), used extensively in India as fodder for horses and cattle. See CHICK-PEA in SUPP.

GRAMINEÆ. See GRASSES.

GRANBY, JOHN MANNERS, MARQUIS OF, English general, son of the Duke of Rutland, was born on Aug. 2, 1721, and educated at Eton and Cambridge. He raised a foot regiment in 1745 during the Jacobite troubles, but it was disbanded at the close of the following year. He became colonel of horse-guards in 1758 and lieutenant-general in 1759. He commanded the British troops in the Seven Years' War (1760–63) and gained a reputation for bravery and skill, and was commander-in-chief of the British army from 1766 to 1770. He was elected to parliament for Cambridgeshire in 1754, 1761, and 1768. He died at Scarborough on Oct. 18, 1770. His immense popularity, which was, however, scarcely earned by his merits as a general, was in part attested by the frequent use of his name for inns and public-houses. While holding the post of commander-in-chief he was attacked in several of the letters of Junius.

GRANT, SIR ALEXANDER, Bart., was born in New York on Sept. 13, 1826, and educated at Harrow and Oxford, where he became public examiner in 1856. In 1859 he was appointed inspector of schools in the Madras Presidency, and in the following year he became professor of history and political economy in Elphinstone College, Madras. In 1862 he became principal of that college, and in the next year he succeeded Sir J. Arnould as vice-chancellor of Bombay University, a post which he held till 1868. He became director of public instruction in Bombay Presidency in 1865, and in this capacity rendered great public services. In 1868 he was appointed principal of the University of Edinburgh, a post which he held till his death on Nov. 30, 1884. He is best known by his annotated edition of Aristotle's Ethics (first published 1857), and his Story of the University of Edinburgh (1884), published in connection with the University Tercentenary. He also published Happiness and Utility as promoted by the Higher Education of Women (1872).

GRANT, SIR FRANCIS, artist, was born at Edinburgh on 18th January, 1803. He was the fourth son of Francis Grant, laird of Kilgraston, from whom he inherited a considerable fortune. Educated at Harrow and Edinburgh University, it was intended that he should become a lawyer, but after having spent all his patrimony he turned his attention to painting. Without having received any special training he soon acquired a reputation as a painter of sporting scenes combined with portraiture. His first picture, The Breakfast Scene at Melton, was exhibited at the Royal Academy in 1834, and this was followed by The Meeting of H. M. Staghounds on Ascot Heath (1837), The Melton Hunt (1839), A Shooting Party at Rawton Abbey (1841), and The Cottesmore Hunt (1848). He was now recognized as the fashionable portrait-painter, among his more notable productions being portraits of Queen Victoria and the Prince Consort, the Prince of Wales, Lord John Russell, Benjamin Disraeli, Lord Clyde, Viscount Palmerston, Sir Walter Scott, John Gibson Lockhart, Sir James Hope Grant (his brother), Archbishop Sumner, Sir George Grey, and the Marchioness of Waterford. He was elected

an associate of the Royal Academy in 1842, an academician in 1851; while in March, 1866, he became President of the Academy, and soon afterwards received the honour of knighthood. He died at Melton Mowbray on 5th October, 1878.

GRANT, James, novelist, was born at Edinburgh on 1st August, 1822. His father, Captain Grant, had served with distinction in the 92nd Gordon Highlanders during the Peninsular war, and in 1833 he received a command in Newfoundland, whither he went with his family. Returning to England in 1839, young Grant obtained an ensigncy in the 62nd Foot. He was soon promoted to command the depot at Chatham, but in 1843 he resigned his commission and entered the office of Mr. Rhind, architect, Edinburgh. Soon thereafter, however, he turned his attention to literature, and in 1845 he published his first novel, entitled The Romance of War. This highly successful venture was followed by such works as The Adventures of an Aide-de-Camp; Walter Fenton, or The Scottish Cavalier; The Yellow Frigate; Bothwell; Jane Seton; Philip Rollo; Frank Hilton, or the Queen's Own; Harry Ogilvie, or the Black Dragoon; Lucy Arden; The Master of Aberfeldie; Playing with Fire; &c. Among his historical works were: Memoirs of Sir W. Kirkaldy of Grange; Memorials of the Castle of Edinburgh; Memoirs of Sir J. Hepburn; Memoirs of Montrose; The Cavaliers of Fortune, British Battles on Land and Sea; Old and New Edinburgh; Scottish Soldiers of Fortune. In 1875 he joined the Roman Catholic church. He died in London on 5th May, 1887.

GRANT, James Augustus, soldier and traveller, was the son of the Rev. James Grant, of Nairn, where in 1827 he was born. Educated at Aberdeen in the grammar-school and at Marischal College, he joined the Indian army in 1846. He fought through the mutiny and took part in the relief of Lucknow, where he was wounded. He accompanied the Abyssinian expedition in 1868, and retired from the army in 1872 with the rank of lieutenant-colonel. It is, however, as an African traveller that he is best known. He accompanied Captain Speke in his search for the sources of the Nile (1860–63), when they explored the Victoria Nyanza and were rewarded by the discovery of the river issuing from the north of the lake. This expedition was described in a volume entitled A Walk Across Africa (1874), and in the Journal of the Royal Geographical Society. His death occurred at Househill, Nairn, on the 11th February, 1892. He received the gold medal of the Royal Geographical Society, and was made a C.B. in 1866.

GRANT, Sir James Hope, general, youngest son of Francis Grant of Kilgraston, was born there on 22nd July, 1808. Educated at Edinburgh and in Switzerland he received a commission as cornet in the 9th Lancers, and took part in the first Chinese war, rising to the rank of major. In 1844 he proceeded to India and engaged in the first and second Sikh wars, distinguishing himself at the battles of Sobraon, Chillianwalla, and Gujerat. At the outbreak of the mutiny in 1857 he was appointed to the command of the cavalry which marched to the relief of Delhi, and he co-operated in the capture of the town. In all the subsequent movements of this war he was conspicuous, taking part in the relief of Lucknow, the battle of Cawnpore, and having command of the force which finally suppressed the revolt. In 1860 he proceeded to Hong Kong, with the rank of lieutenant-general, to take command of the force which was to co-operate with the French against China. Notwithstanding the inertness of his allies, Grant speedily captured the Taku forts, seized Peking, and forced the enemy to accept his terms. Returning to India he was appointed commander-in-chief of the Madras army, in 1865 became quarter-master-general at the Horse-guards, and in 1870 was selected for the command at Aldershot. He died March 7, 1875. Incidents in the Sepoy War, 1857–58, and Incidents in the China War, 1860, were published from his journals and edited by Major H. Knollys. See the Life by the same editor (two vols., 1894).

GRANVILLE, Granville George Leveson-Gower, Second Earl, K.G., English statesman, was born in London on May 11, 1815. He was educated at Eton and Christ Church, Oxford; entered parliament in 1836 for Morpeth, afterwards for Lichfield, both in the Liberal interest. In 1840 he became under-secretary for foreign affairs, in 1846 succeeded to the peerage, in 1848 was appointed vice-president of the Board of Trade, and in 1851 succeeded Palmerston as foreign secretary, going out of office in the following year. In 1855 he became chancellor of the Duchy of Lancaster, president of the council, and ministerial leader of the House of Lords (1855–58). From 1859 to 1866 he was again president of the council, having previously failed to form a ministry under himself as premier. In 1868 he was colonial secretary under Gladstone, and on the death of Clarendon in 1870 succeeded to the secretaryship for foreign affairs, which he held until 1874. During this period he negotiated the Treaty of 1870, guaranteeing the independence of Belgium, and 'protested' against the Russian repudiation of the Black Sea clause of the Treaty of Paris. On the return of Gladstone to office in 1880 Lord Granville again became foreign secretary, until Lord Salisbury came into power in 1885. In the short Gladstone ministry of 1886 he was colonial secretary, and he followed his chief on the question of Irish Home Rule. He died on Mar. 31, 1891

GRASS-CLOTH, the name of certain beautiful light fabrics made in the East from the fibre of *Boehmeria nivea*, or China grass, *Bromelia Pigna*, &c. None of the plants yielding the fibre are grasses. See Boehmeria.

GRASS OF PARNASSUS, a genus of plants, variously referred to the natural orders Droseraceæ and Saxifragaceæ, and found for the most part in boggy situations in the colder northern countries. The common grass of Parnassus (*Parnassia palustris*), well known in Britain, is a beautiful autumnal plant with heart-shaped leaves and a single yellowish-white flower.

GRASS-OIL, Oil of Geranium, or Oil of Spikenard, a fragrant volatile oil, used chiefly in perfumery, and obtained from Indian grasses of the genus *Andropogon*. *A. schœnanthus* produces lemon-grass oil. See Andropogon in Supp.

GRAVELOTTE, a village of Germany in the province of Elsass-Lothringen, 7 miles west of Metz, the scene of one of the fiercest battles of the Franco-German war (which see).

GRAVITY, Specific. See Specific Gravity.

GRAY, Asa, American botanist, was born at Paris, in Oneida county, New York state, on Nov. 18, 1810, and died at New York on Jan. 31, 1888. He studied medicine and graduated in 1831, but gave up his practice and devoted himself to botanical studies. In 1834 he was appointed botanist to the Wilkes exploring expedition, but owing to the prolonged delay in starting he resigned in 1837. In 1842 he became Fisher professor of natural history at Harvard, a post which he occupied till his retiral in 1873. Dr. Gray ranks among the leading botanists of the nineteenth century, and

he is unquestionably the greatest master of that science that the United States have produced. Among his numerous works we may mention the following: Flora of North America (1838, with Dr. Torrey; not finished in that form); Genera Floræ Americæ Boreali-Orientalis Illustrata (1848–50); Structural and Systematic Botany (1858); Manual of the Botany of the Northern United States (1848); Lessons in Botany and Vegetable Physiology (1857); A Free Examination of Darwin's Treatise on the Origin of Species, and of its American Reviewers (1861); Field, Forest, and Garden Botany (1868); Structural Botany, or Organography on the Basis of Morphology (1879); Darwiniana (1876); Synoptical Flora of the United States (1878); Natural Science and Religion (1880). He also wrote a large number of scientific papers and reports, and he was a supporter of Darwin's theory of natural selection. An edition of his Scientific Papers was published in 1889, and his Letters appeared in 1893.

GRAY, David, Scottish poet, was born at Merkland, Dumbartonshire, on Jan. 29, 1838, his father being a handloom weaver. He became a pupil-teacher in Glasgow and studied at Glasgow University, from which he went, with Robert Buchanan, to London in 1860 to try his fortune in literature. After a brief struggle, during which he was assisted by Lord Houghton and Sydney Dobell, consumption set in, and he died at Merkland on Dec. 3, 1861. A small volume containing the poem entitled The Luggie, some lyrics, and a few sonnets, represents the whole of his work It shows not a little promise for one who died in his twenty-fourth year. See David Gray, and other Essays (1868), by Robert Buchanan.

GRAY-LAG. See Goose.

GRAYS THURROCK, a town of England, in Essex, on the Thames, on the railway to Tilbury and Southend. The district is interesting from a geological and palæontological point of view. It contains chalk quarries and lime, cement, and brick works. Pop. in 1891, 12,219; in 1901, 13,831.

GRAYWACKE. See Greywacke.

GREELEY, Horace, American journalist and politician, born at Amherst, New Hampshire, 3rd February, 1811; died at Pleasantville, New York, 29th November, 1872. Adopting the trade of a printer, he was able, after various literary adventures, to found in 1841 the *New York Tribune*, with which his fame is chiefly connected. He was a lifelong opponent of slavery, and was largely instrumental in securing the election of Abraham Lincoln to the presidency. During the civil war he strongly advocated the union cause, and at its close he advocated a policy of universal amnesty with universal suffrage. He held a deservedly high place as a faithful public servant, though his social and mental eccentricities detracted something from his value. Whittier described him as 'our later Franklin'. He was elected to Congress for a short term in 1848, and in 1872 was an unsuccessful candidate for the presidency. He wrote, amongst other works, The American Conflict (two vols., 1864–66); Recollections of a Busy Life (1868); Essays on Political Economy (1870); and What I Know of Farming (1871).

GREEN, John Richard, an English historian, was born at Oxford in 1837, received his early education at Magdalen College School and under private tutors, and gained a scholarship at Jesus College, but never read for any sort of honours, his studies being principally in the way of history. Immediately after taking his degree, in 1860 he was appointed curate of St. Barnabas, King Square, in the east end of London, and in 1866 to the vicarage of St. Philip's, Stepney. While still continuing his historical studies he never neglected his parish duties—duties made infinitely more arduous by the visit of the cholera in 1868. Soon after that year, however, the state of his health compelled him to resign his living, and he was appointed to the post of Lambeth Librarian by Archbishop Tait. His work as librarian occupied but little of his time, and he now collected and digested the materials for a projected history, which was completed and published in 1874 under the title of A Short History of the English People. It had an enormous success, the common opinion being that it is the best general history of the country as yet written. The author recast it on a larger scale, the new book appearing at intervals between 1877 and 1880 in four vols. In recognition of his literary ability his college at Oxford made him an honorary fellow, and the University of Edinburgh gave him the degree of LL.D. He also projected and edited a series of History and Literature Primers, which have had much success. In 1881 was published his last important work, a volume on the beginnings of English history, entitled The Making of England, which is one of the most valuable works of its kind in the language. In spite of repeated winter-visits to the Continent he never recovered sound health, and on 7th May, 1883, he died at Mentone. An unfinished work of his, The Conquest of England, was published after his death. The 1888 edition of the Short History contains a sketch of Green's life by his wife, Alice Stopford. In 1892–93 she and Miss Norgate issued an illustrated edition of the work. Mrs. Green has written works on Henry II. (1888) and Town Life in the Fifteenth Century (1894).

GREEN, Thomas Hill, English philosophical writer, was born at Birkin rectory, Yorkshire, on April 7, 1836 At fourteen years of age he was sent to Rugby, whence he passed in 1855 to Balliol College, Oxford. He was elected a fellow of Balliol in 1860, and first lay tutor on that foundation in 1866. In 1878 he was appointed Whyte's professor of moral philosophy, but his work was abruptly closed by his death on 26th March, 1882. Apart from his Prolegomena to Ethics, published posthumously under the editorship of Mr. A. C. Bradley in 1883, the bulk of his work was in the form of articles contributed to the North British and Contemporary Reviews. He was one of the strongest opponents of the English empirical school. His philosophical system was founded mainly on those of Kant and Hegel. It had a lofty ethical and idealist character; and with him philosophy went hand in hand with strenuous efforts for social and moral reform. A collected edition of his works was published by R. L. Nettleship (1885–88) in three volumes. The first contains his Introduction to Hume's Treatise on Human Nature, and his Criticisms of Herbert Spencer and George Henry Lewes. The second includes his Lectures on Kant's Critique of Pure Reason and Metaphysic of Ethics, a lecture On the Logic of the Formal Logicians and of J. S. Mill, and On the Principles of Political Obligation. In the last volume are published an Essay on Aristotle, and a paper on Popular Philosophy in Relation to Life, together with a Memoir and Portrait.

GREEN BAY, a town of the United States, Wisconsin, on the Fox river, at the head of Green Bay, an inlet from Lake Michigan. It has a good harbour and a considerable trade, and is a favourite summer resort. Pop. (1890), 9069; (1900), 18,684.

GREEN-SICKNESS. See Chlorosis.

GREEN-WEED, dyer's weed (*Genista tinctoria*). See Genista.

GREUZE, JEAN BAPTISTE, a famous French painter, was born at Tournus, in Burgundy, on August 21, 1725, and died at Paris on March 21, 1805. After studying at Lyons he went to Paris and entered the Academy of Painting there. His first picture, Le Père de Famille expliquant la Bible, obtained great success in 1755, and in that year also he became associate of the Academy. He then set out on a visit to Rome, and several of his subsequent pictures deal with Italian scenes. He quarrelled with the Academy over their regulations, and finally, after a partial reconciliation, he ceased to exhibit there. During the period of the Revolution his popularity rapidly lessened, and he died in poverty. Although he devoted some time and attention to historical subjects, he latterly confined himself to depicting scenes of the family life of the *bourgeois* or middle class. As a colourist he occupies a high place. Some of his chief works are: The Broken Pitcher; Septimius Severus reproaching Caracalla; Triumph of Galatea; Psyche crowning Love; Innocence; Throwing a Kiss; Interior of Peasant Cottage; Sulky Boy; and many studies of heads, young girls, &c. Most of his paintings have been engraved.

GREY, SIR GEORGE, statesman and colonial governor, was born at Lisbon on April 14, 1812, shortly after his father had been killed in the assault on Badajoz. He was educated at the Royal Military College, Sandhurst, entered the army in 1829 as ensign in the 83rd Regiment, and became captain in 1839, after which he sold out. Previous to this he had led an exploring party in North-western Australia, and in 1839 he returned to complete his exploration. The results were published in his Journals of Two Expeditions of Discovery in North-west and Western Australia during 1837-39 (two vols., 1841). In 1841 he was appointed governor of South Australia, then in a somewhat critical position. He discharged the duties of this office with conspicuous ability, and in 1846 he became governor of New Zealand. His tenure of office was marked by troubles with the Maoris and difficulties of various kinds, but his firmness, tact, and sympathy proved equal to them all. In 1854 he was appointed to the governorship of the Cape Colony, where his administrative and military capacity was taxed to the utmost. His prompt despatch of all available troops to aid the Indian government in putting down the mutiny is a well-known incident of this period. He succeeded in gaining the confidence of all the South African races, and his temporary recall in 1859 produced dismay throughout South Africa. He was reappointed almost immediately, and held office till 1861, when he again went to New Zealand as governor. Wars with the Maoris rendered his governorship on this occasion a somewhat stormy one, and having latterly given offence to the home authorities, he was recalled in 1867, the New Zealand parliament expressing its regret and sympathy. For some years he resided in England, but he subsequently returned to New Zealand, and in 1875 became superintendent of the province of Auckland. Two years later he became premier of New Zealand. He resigned this office in 1880, but remained a member of the legislature till 1890. He latterly resided in England, and died in London on September 19, 1898. He was created K.C.B. in 1848, and in 1894 he became a privy councillor. In addition to the work above mentioned, Sir George Grey published Poems, Traditions, and Chaunts of the Maories (in Maori, 1853); Polynesian Mythology and Ancient Traditional History of the New Zealand Race (1855); and Proverbial Sayings of the Ancestors of the New Zealand Race (1858). See Life and Times of Sir George Grey (two vols., 1892), by W. L. and L. Rees.

GREY FRIARS. See FRANCISCANS.

GRIFFITHS' VALUATION, the valuation of the land of Ireland for taxation, carried out between 1830 and 1840 under Sir Richard Griffiths.

GRILSE. See SALMON.

GRINSTEAD, EAST, an urban district and market town of England, in East Sussex, 16 miles due north of Lewes, giving name to a parl. division. It has an old church (restored), Sackville College, an old alms-house, an orphanage founded by Dr. J. M. Neale, &c. Brewing and brick-making are industries. Pop. in 1891, 5180; in 1901, 6094.

GRIPES, a painful affection of the bowels, caused by constipation or diarrhœa. See CONSTIPATION, DIARRHŒA, COLIC.

GRIT. See SANDSTONES.

GRIVEGNÉE, a town in Belgium, in the province of Liége, on the Vesdre. It manufactures steam-engines, and has worsted and fulling mills. Pop. (1897), 10,358.

GROUND-ANNUAL, in Scottish law, the rent paid for a piece of ground that is built upon to one who holds the ground in feu. It may thus be a perpetual annuity. It is similar to the English term *Ground-rent*.

GROUND DOVE, a name of various species of pigeons, which resemble the gallinaceous birds in living mainly on the ground, their feet being better suited for walking than perching. The name is especially given to the members of the genus *Chamæpelia*, small birds belonging to the warmer parts of America, and includes the bronze-wing pigeons of Australia. The large pigeons of the genus *Goura* are also so called. See PIGEON.

GROUND-HOG, same as AARD-VARK. See ORYCTEROPUS.

GROUND IVY, *Glechoma hederacea*, or *Nepeta Glechoma*, a common British plant of the order Labiatæ, with a creeping stem and purple flowers. The leaves are crenate-reniform and the flowers are in threes. Tea made from it is used by the poor for pectoral complaints It was formerly employed to flavour ale.

GROUND-NUT. See ARACHIS.

GROVE, SIR GEORGE, English writer, was born at Clapham, Surrey, on August 13, 1820. He was educated as a civil engineer, in which capacity he was connected with the Britannia Bridge and other important works. In 1849 he became secretary to the Society of Arts, and from 1852 till 1873 he was secretary to the Crystal Palace Company, and did much for the popularizing of classical music in connection with its concerts. From 1882 till 1894 he was director of the Royal College of Music. For some years he edited Macmillan's Magazine, and he was editor of, and a contributor to, the great Dictionary of Music, published in 1878–1889. He was also an extensive contributor to Smith's Dictionary of the Bible. Of his other writings we may mention Primer of Geography (1877), and Beethoven and his Nine Symphonies (1896). He was knighted in 1883, and he was D.C.L. of Durham (1872) and LL.D. of Glasgow (1886). He died on May 28, 1900.

GUALEGWAYCHÚ, a town of the Argentine Republic, in the province of Entre Rios, on a river of same name 11 miles above its mouth in the Uruguay. It contains a tannery, some mills, slaughter-houses, &c. Pop. (1895), 13,282.

GUANACO. See LLAMA.

GUANARE, a town of Venezuela, capital of Zamora state. It is situated near the upper course of the Rio Portuguesa, and is about 220 miles from

Carácas in a south-westerly direction. Coffee, sugar-cane, &c., are cultivated, and cattle are largely reared in the district. Pop. 11,000.

GUELDER ROSE, or GUELDRES ROSE, a name given to the cultivated variety of the *Viburnum Opulus*, or water elder, of the order Caprifoliaceæ. On account of the shape and colour of its flowers it is sometimes called the Snowball Tree. Its fruit is of a pretty red colour. In the wild form, which is found plentifully distributed throughout England and Ireland and more rarely in Scotland, the inflorescence is a dense cyme whose outer flowers are barren and enlarged, but in the cultivated form all the flowers are neuter and consequently the plant can never set seed. A yellow dye is obtained from it, and the wood is sometimes employed in making tobacco-pipes and other articles.

GUELPH, a town of Canada, in the province of Ontario, on the Speed, a tributary of the Grand River, in a rich farming district, 45 miles W. of Toronto. It has manufactures of woollens, carpets, organs, sewing-machines, and agricultural implements, and a model farm kept up by the provincial government in connection with Ontario Agricultural College, which is also located here. A fall on the river provides abundant water-power. Pop. (1901), 11,496.

GUERNSEY LILY, *Nerine sarniensis*, a beautiful amaryllidaceous plant, with purple-red flowers, native of South Africa, so called from some of its bulbs being cast up in Guernsey from a wrecked ship and there taking root. Several other species of lily-like plants are also called Guernsey lilies.

GUIANA BARK, the bark of *Portlandia hexandra*, of the order Cinchonaceæ, considered to possess great value as a febrifuge. The tree has elliptical, stipulate leaves, and large white flowers.

GUINEA-CORN, a name given to durra, one of the grains also called millet. In the United States it is cultivated under the name of broom-corn. See MILLET.

GUIZOT, FRANÇOIS-PIERRE-GUILLAUME, French historian and statesman, was born at Nîmes 4th October, 1787, of a Calvinist family. In 1794 his father, a lawyer, perished on the scaffold as one of the victims of the revolution. His mother retired with her sons to Geneva, at the gymnasium of which he was educated. In 1805 he went to Paris to study law, but he gradually drifted into the profession of letters, and after the publication of several works now mostly forgotten, he married, in 1812, Mlle de Meulan, the editor of Le Publiciste, and saw opened to him a political career. In the same year he became professor of modern history in the Sorbonne, and produced a translation of Gibbon's history. On the fall of the empire he was named successively secretary-general to the ministry of justice, *mâitre des requêtes*, councillor of state, and director-general of the departmental and communal administration. In 1816 he published the works, Du Gouvernement Représentatif et de l'État Actuel de la France, and Essai sur l'Instruction Publique. After the assassination of the Duke of Berry (Feb. 1820) his party, then headed by the Duke Decazes, fell before an ultra-royalist reaction, against which Guizot stood out as a resolute opponent. His literary activity during the term of opposition took a wider range, and from this time he began the series of great historical publications on which his fame chiefly rests. He published in 1821 Des Moyens de Gouvernement et d'Opposition dans l'État Actuel de la France. His Histoire du Gouvernement Représentatif (1821–22) was a résumé of his lectures at the Sorbonne. Collection des Mémoires relatifs à la Révolution d'Angleterre (twenty-six vols., begun in 1823) was a translation from English sources by various authors, edited and annotated by Guizot; a Collection de Mémoires relatifs à l'ancienne Histoire de France, likewise begun in 1823, extended to thirty-one vols. He also revised a translation of the works of Shakspere, and contributed to the Revue Françoise and L'Encyclopédie Progressive. In 1825, on account of his opposition to government and the political character given to his lectures, he was deprived of his chair, and was not restored till 1828. The labours of his chair occupied most of his time till 1830. His Cours d'Histoire Moderne, l'Histoire générale de la Civilization en Europe, and l'Histoire générale de la Civilization en France—works of which there have been numerous editions—are the fruit of his professorship. In 1830 he was elected to the chamber of deputies, and after the revolution of July by which Louis Philippe became king of the French, he was named minister of the interior, and was afterwards minister of public instruction, in which post he did great service in organizing primary instruction in France. In 1840 Guizot accepted the post of ambassador to London, but the intrigues of this period, too complicated to describe in detail, greatly damaged his reputation. In October, 1841, he became, as minister of foreign affairs under the nominal premiership of Marshal Soult, the real head of the government of Louis Philippe, a position he held till 1848. Resting for support upon the limited class who then alone possessed the electoral franchise, he met with an unbending front every suggestion of reform, while repression and corruption formed the mainstays of his power. At length, on 23rd February, 1848, Louis Philippe dismissed him, and on the following day himself abandoned the Tuileries. Guizot escaped a few days after in the dress of an artisan, and took refuge in England. His subsequent public appearances were few and without important results, the rest of his life being almost entirely that of a man of letters. He repeatedly presided over the Protestant consistory, and was regarded as the head of the orthodox Protestants of France. He was, however, a zealous supporter of the temporal power of the Pope. During his later years, spent on his estate in Normandy, he wrote numerous political letters, but his chief employment was the revision and extension of his literary works. Besides those already referred to we may mention: Washington (1841); Discours sur la Révolution d'Angleterre (1850); Méditations et Études Morales (1851); Guillaume le Conquérant; Sir Robert Peel; Mémoires pour servir à l'Histoire de mon Temps (nine vols. 8vo, 1858–68); L'Église et la Société Chrétienne en 1861 (1861); Discours Académiques (1861); Trois Générations, 1789, 1814, 1848 (1863); Recueil Complet des Discours prononcés dans la Chambre de 1819 à 1848 (five vols., 1863–64); Méditations sur l'Essence de la Religion (1864); Méditations sur l'État Actuel de la Religion Chrétienne (1865); Méditations Biographiques et Littéraires (1868); Histoire de France racontée à mes Petits Enfants (1870–75). The last work was not quite finished at his death, but it was completed by his daughter. He died 12th September, 1874. His more important works have been translated into English.

GUJRANWÁLA, a town of India, in the Punjab, administrative head-quarters of a district of the same name in the Lahore division. It stands on the Northern Punjab State railway, 40 miles north of Lahore. It has inconsiderable manufactures of country wares, such as brass vessels, &c. Pop. (1891), 26,785; (1901), 29,224.

GUJRÁT, a town of India, in the Punjab, in the Rawál Pindi division, 5 miles from the Chenab, is

a commercial centre. Its manufactures are principally of cotton and of Gujrát ware, that is, inlaid work in gold and iron. Pop. (1891), 18,743.

GULBARGA, a town of India, in the state of Hyderabad, 110 miles west of Hyderabad, once the capital of a powerful dynasty, with a large mosque, an old fort, and various remains of former grandeur. Pop. (1891), 28,200; (1901), 29,228.

GULEDGARH (*Guledgud*), a town of India, in the Bijapur district, Bombay Presidency, 9 miles north-east of Bádámi. It has manufactures of cotton and silk cloth, and in the neighbourhood are valuable stone quarries. Pop. (1891), 15,481.

GUM-CISTUS (*Cistus ladaniferus*), a plant largely cultivated in Portugal, and yielding a gum of a pleasant balsamic odour. See CISTUS in SUPP.

GUM-DRAGON. See TRAGACANTH in SUPP.

GUM-ELASTIC, caoutchouc or india-rubber. See CAOUTCHOUC.

GUM-TREES, a general name for trees of the genus *Eucalyptus* (which see).

GUNDAMUK. See GANDAMAK in SUPP.

GURKHAS. See GOORKHAS.

GURMUKTESWAR, a town of British India, in the Meerut district of the United Provinces, on the Ganges, which is here crossed by a much-frequented ferry. A great annual fair attracts 200,000 pilgrims from all parts of the country. Pop. (1891), 6707.

GUTTIFERÆ, or CLUSIACEÆ, a natural order of dicotyledonous trees or shrubs, having affinities with the St. John's-Wort order (Hypericaceæ), which generally secrete an acrid yellow resinous juice, in some cases of considerable value, as the gamboge yielded by the *Garcinia Morella*, or the tacamahac from the *Calophyllum inophyllum*. They are found in the humid and hot places of tropical regions, chiefly South America. The fruit of some is highly esteemed, in particular the mangosteen and the mammee apple. See CALOPHYLLUM in SUPP.; also MANGOSTEEN, MAMMEE-TREE, GAMBOGE, and TACAMAHAC.

GUTZKOW, KARL FERDINAND, German writer, was born at Berlin on Mar. 17, 1811. After studying theology he took to journalism and politics, and became the leading spirit of a small body of reformers known as 'Young Germany'. In 1835 his novel Wally die Zweiflerin appeared. It was at once confiscated by the government as hostile to religion and society, and the author was imprisoned for three months. While in prison he wrote a work Zur Philosophie der Geschichte (1836). In spite of government prohibition Gutzkow managed to publish a number of works from Hamburg, where he had settled. Amongst these are: Beiträge zur Geschichte der neuesten Litteratur (1836), Goethe im Wendepunkte zweier Jahrhunderte (1836), Zeitgenossen (1837), Seraphine (1837), Blasedow und seine Söhne (1838), a satire, and Börne's Leben (1840). He was active, also, in dramatic literature, his tragedies Richard Savage (1840), Patkul (1841), and Uriel Acosta (1847), and his comedies Zopf und Schwert (1844) and Das Urbild des Tartufe (1847), having been very popular. In 1842 he left Hamburg, and after a visit to Paris, described in Briefe aus Paris, settled at Frankfort till 1847, when he became director of the Dresden theatre. Here he devoted himself to novel-writing, producing among others the two great romances Die Ritter vom Geist (1850–52), and Der Zauberer von Rom (1858–61). He died at Frankfort on Dec. 16, 1878. His collected works were published at Jena in 1873–82. The dramatic works occupy twenty volumes, and his novels and other works other twelve.

GWELO, a town of Southern Rhodesia, 110 miles north-east of Buluwayo, in a gold-producing region. Traces of ancient gold workings are abundant in the district. The white population numbers about 200.

GYMNOSPERM, in botany, a plant with a naked seed. Among the gymnosperms are pines and firs, yews, joint-firs, the cycads, &c., belonging to the three orders, Cycadeæ, Coniferæ, and Gnetaceæ, of which the second is much the most important and the only one represented in Britain. In the gymnosperms there is no proper ovary, the seeds being fertilized by the pollen coming into direct contact with the foramen of the ovule without the intervention of a stigma.

GYMPIE, a municipal town of Australia, in Queensland, on the side of a range of hills overlooking the river Mary, 107 miles north of Brisbane. It owes its origin to the gold-fields discovered here in 1867, which have yielded good results. Among the chief buildings are the school of arts (with library), the hospital, the theatre, the courthouse, post and telegraph offices, several halls, various churches, schools, and banks, the stock and other exchanges, &c. Pop. (1901), 11,959.

GYPAËTUS, the genus of birds to which belongs the Bearded Vulture or Lämmergeyer of the Alps. See LÄMMERGEYER.

H.

HAAG, CARL, painter in water-colours, was born at Erlangen, in Bavaria, on April 20, 1820 He studied art at Nuremburg and afterwards at Munich and Rome, and settled in England in 1847. Having devoted himself exclusively to water-colour painting, he was elected a member of the Royal Society of Painters in Water-colours in 1850. He afterwards travelled extensively in Dalmatia, Montenegro, Greece, Egypt, and the Holy Land. For some time he lived amongst Bedouin tribes, and their life provided the subjects of some of his best pictures. Amongst his pictures the following are some of the most important: The Royal Family ascending Loch-na-gar; Evening at Balmoral; The Queen and Prince Consort fording Pool Tarff; The Ancient Vestibule beneath the Temple Area, and other pictures of scenes in Palestine, Syria, &c.; The Anazeh Bedaween departing from Palmyra; A Bivouac in the Desert; The Arrival at a Well in the Desert; Desert Hospitality; A Bedaweep's Devotion; Danger in the Desert; A Caravan of Bedaween encamping near the Sphinx of Ghizeh against an approaching Sandstorm; and La Illah il Allah.

HACKLÄNDER, FRIEDRICH WILHELM VON, a German novelist and comedy writer, was born near Aix-la-Chapelle on Nov. 1, 1816. He engaged first in commerce, then entered the Prussian artillery, and commenced his literary career in 1841 with Pictures from a Soldier's Life in Time of Peace (Bilder aus dem Soldatenleben im Frieden). He

then became successively private secretary to Baron Taubenheim, whom he accompanied to the East, and to the Crown Prince of Würtemberg, with whom he travelled in many parts of Europe. In 1849 he served with the Austrians during the war with Sardinia, and published his observations in Soldier Life in Time of War (Bilder aus dem Soldatenleben im Kriege, 1849-50). He was ennobled by the Emperor Francis Joseph in 1861. He died near Munich on July 6, 1877. Amongst his many writings, distinguished by a mixture of pathos and humour, we may mention Daguerreotypen (1842); Pilgerzug nach Mekka (1847); Bilder aus dem Leben (1850); Handel und Wandel (1850); Ein Winter in Spanien (1855); Das Geheimnis der Stadt (1868); Der Neue Don Quixote (1858); Geschichten im Zickzack (1870); of his comedies, Der Geheime Agent (1850) was the most successful. Several of his works have appeared in English translations.

HADEN, Sir Francis Seymour, surgeon and etcher, was born in London on Sept. 16, 1818, and educated first in University College, London, and afterwards at the Sorbonne and in the medical colleges of Paris and Grenoble. In 1842 he became a member of the Royal College of Surgeons, and in 1857 he was elected a Fellow. He has contributed largely to the revival of etching in Britain by founding the Royal Society of Painter Etchers, of which he is still president, and by his publications on that subject, of which we may mention Études à l'Eau Forte (1865-66), About Etching (1879), and The Etched Work of Rembrandt (1879). His own etchings have been collected by Sir. W. R. Drake, under the title of The Etched Work of Francis Seymour Haden, and consist of about 200 plates. He has also identified himself with the question of burial reform, but he is opposed to cremation. He was made a Knight of the Bath in 1894. His eldest son, Francis Seymour Haden, has held several important posts in the government of Natal.

HADRIAN'S WALL, or the Pictish Wall, a wall quite as often associated with the name of Severus.

HÆCKEL, Ernst Heinrich, celebrated German naturalist, was born at Potsdam on Feb. 16, 1834. He studied with great distinction in natural science and medicine at the universities of Berlin, Würzburg, and Vienna, afterwards going to Italy. In 1862 he became extraordinary professor, and in 1865 ordinary professor of zoology at Jena, and in spite of many splendid offers from leading continental universities he has remained there ever since. He has travelled in almost every country of Europe, and also in India, Arabia, Morocco, and elsewhere. Professor Hæckel has written many brilliant works on Zoology, including such as Die Radiolarien (1862), Siphonophora (1869), Die Kalkschwämme (1872), System der Medusen (1879), and several extremely valuable volumes in the reports of the *Challenger* expedition. These works are all splendidly illustrated. He has also published several other treatises of a more general character, such as his Generelle Morphologie (1866), a work showing great scientific skill and profound research, and his treatise on the Perigenesis of the Plastidules (1876). He at once accepted Darwin's theory of the origin of species by natural selection, and has illustrated, developed, and speculated on it in several works that have attained great popularity not only in Germany but throughout Europe. Of these the best-known is his Natürliche Schöpfungsgeschichte (Natural History of Creation, 1868), which has often been translated, and the others include Anthropogenie (1874) and Gesammelte populäre Vorträge auf dem Gebiete der Entwickelungslehre (1878-79). Of his remaining publications we may mention A Visit to Ceylon (in English, 1883), his famous reply to Virchow entitled Freie Wissenschaft und freie Lehre, The Pedigree of Man, and other essays (in English, 1883), and Kunstformen der Natur (1899). Among Hæckel's contributions to the solution of zoological problems are his sketching of the genealogical tree of the animal kingdom, his formation of a kingdom of Protista to include organisms which cannot be with certainty classified either as animals or as plants, and his exposition of ontogenetic development as a rapid recapitulation of phylogenetic evolution.

HÆMATEMESIS, a vomiting of blood from the stomach, resulting from some disease of that organ, as ulcer or cancer. See Hemorrhage.

HÆMATURIA (Gr. *haima*, blood, and *ouron*, urine), a discharge of bloody urine, usually arising from disease of the kidneys or bladder. In some parts of Africa it is an endemic disease arising from a parasite in the blood.

HÆMOPTYSIS (Gr. *haima*, blood, and *ptysis*, a spitting), the coughing up of blood, sometimes produced by fulness of the blood-vessels of the lungs or throat, or by the rupture of blood-vessels as a consequence of ulceration. It is distinguished from blood coming from the stomach by the comparative smallness of its quantity and by its usually florid colour. It occurs in heart-disease, in pneumonia, and tubercular disease. It is sometimes a case of vicarious menstruation. Ice is useful in checking the bleeding, and among medicines used in such cases are dilute sulphuric acid, gallic acid, ergotine, &c. See Hemorrhage.

HAGGARD, Henry Rider, English novelist, was born at Bradenham, Norfolk, on June 22, 1856. He was educated at Ipswich grammar-school and in private, and in 1875 he went to Natal as secretary to Sir Henry Bulwer. From 1876 till 1877 he served on the staff of Sir T. Shepstone, special commissioner to the Transvaal, and in 1878 he was appointed Master of the High Court of that country. He returned to England in 1879, and five years later was called to the bar at Lincoln's Inn. His first published work was Cetywayo and his White Neighbours (1882), and it was soon followed by the novels Dawn (1884) and The Witch's Head (1884). He became widely known by his King Solomon's Mines (1886), and still more by his romantic She (1887), which have been followed by Allan Quatermain (1887); Jess (1887); Maiwa's Revenge (1888); Cleopatra (1889); Eric Bright-eyes (1891); Montezuma's Daughter (1894); Joan Haste (1895); The Heart of the World (1895); The Wizard (1896); Dr. Therne (1898); Swallow, a Story of the Great Trek (1899); &c. His tales are strong in incident and adventure, but weak in character-drawing.

HAIDARABAD. See Hyderabad.

HAIFA, a flourishing seaport of Palestine, on the south side of the Bay of Acre, picturesquely situated at the foot of Mount Carmel. In the neighbourhood a colony of Germans belonging to the religious society of the 'Temple' has been formed, and Jews, Germans, Americans, and other foreigners have also settled in the locality. A railway to Damascus is being constructed. Pop. 12,000.

HAJIPUR, a town of India, in the Muzafferpur district, Bengal, on the Little Gandak, a short distance above its confluence with the Ganges. Its command of water traffic gives it considerable commercial importance. Pop. (1901), 21,398.

HALE, Edward Everett, American Unitarian minister and miscellaneous writer, was born at Boston, Mass., on April 3, 1822. He graduated at Harvard, and after a private study of theology

entered the Unitarian Church. For ten years from 1846 he was minister at Worcester, Mass., and from 1856 to 1899 he preached in Boston. He has written a very large number of works of different kinds, some of them being The Rosary (1848); Letters on Irish Immigration (1852); The Man without a Country (1861); Sybaris and other Homes (1870); Ten times One is Ten (1870); Our New Crusade (1875); What is the American People? (1885); Life of George Washington studied anew (1887); Naval History of the American Revolution (1888); Popular Life of Christopher Columbus (1891); A New England Boyhood (1893); Franklin in France (1887–88, with his son, Edward Everett); J. R. Lowell and his Friends (1899). Mr. Hale has been connected with several newspapers and magazines, and in 1869 he founded Old and New, a monthly which he edited till its absorption in Scribner's.

HALIAËTUS, the genus of birds to which belong the white-tailed sea-eagle of Britain, and the white-headed or bald eagle of America, the chosen symbol of the United States. See EAGLE.

HALL, SAMUEL CARTER, author and editor, was born at Geneva Barracks, near Waterford, on 9th May, 1800, and was the son of Colonel Hall, a Devonshire gentleman serving with his regiment in Ireland. He was educated in Cork, came to London in 1822, studied law for a time, and then became a reporter (1823–25) to the New Times. He then established and edited The Amulet (1826–37); edited the New Monthly Magazine (1832); started a newspaper called The Town; sub-edited the John Bull (1837); and became the general manager of the Britannia (1839). In the latter year he began to edit the Art Union Monthly Journal, in which he exposed the traffic in sham old masters, and endeavoured to encourage modern art. The title of this magazine was changed in 1849 to the Art Journal, and under Hall's editorship, which continued to 1880, it grew in importance and public favour. In that year he retirec and Lord Beaconsfield's government granted him a pension of £150. He died at Kensington, London, 16th March, 1889. He was an industrious compiler of books, among his chief productions being: The Book of Gems (three vols., 1836), The Book of British Ballads (1842); Gems of European Art (two vols., 1843); Baronial Halls (1848); and The Gallery of Modern Sculpture (1849–54). His intercourse with the well-known men of the time is embodied in A Book of Memoirs (1871) and The Retrospect of a Long Life (two vols., 1883).—ANNA MARIA (FIELDING) HALL, the wife of the foregoing, was born in Dublin, 6th January, 1800. She came to London at the age of fifteen and was married in 1824. Encouraged by her husband she wrote numerous tales, such as: Sketches of Irish Character (1828); The Buccaneer (1832); The Outlaw (1835); The French Refugee, a drama (1836); Lights and Shadows of Irish Character (1838); Marian (1840); and Midsummer Eve, a fairy tale of love (1848). She was the author of upwards of fifty tales, contributed numerous articles to periodicals, edited the St. James's Magazine for a time, and was actively associated with the founding of several benevolent institutions. She died on 30th January, 1881.

HALLECK, FITZ GREENE, American poet, was born at Guilford, Connecticut, on July 8, 1790. He became a clerk in a New York banking-house, and from 1832 till 1849 was in the employment of John Jacob Astor. In 1819 poems by him and a friend (J. R. Drake) appeared in the New York Evening Post under the signature of Croaker and Co., and attracted some attention. In 1820 he published Fanny, his longest poem, a satire on the follies and fashions of the day. In 1822 he visited Europe. Amongst his best poems are Marco Bozzaris, To the Memory of Burns, Alnwick Castle and Red Jacket. He died at Guilford on Nov. 19, 1867. His Life and Letters and an edition of his works were published in 1869 by James Grant Wilson.

HALLIWELL-PHILLIPPS, JAMES ORCHARD, originally J. O. Halliwell, Shaksperian scholar, was born in Chelsea on June 21, 1820, and died at Brighton on Jan. 3, 1889. He studied at Trinity and Jesus Colleges, Cambridge, but took little interest in the ordinary academic routine. In 1839 he began his editorial labours with a reprint of Mandeville's Travels, and in that year also he was elected F.R.S. He had for some time to work in narrow pecuniary circumstances, but on succeeding to the property of his father-in-law he was enabled to indulge his taste for old and quaint books and curiosities, especially those connected with Shakspere and his works. He was a leading and active member of the Percy and Shakspere societies: for the former he edited the Minor Poems of Lydgate, Early Naval Ballads of England, Nursery Rhymes of England, &c.; and for the latter, The Coventry Mysteries, Tarleton's Jests, The Fairy Mythology of Shakspere, &c. His chief Shaksperian publications are a Life of Shakspere (1848); the Works of Shakspere in sixteen folio vols., only 150 copies printed; Calendar of the Records of Stratford-on-Avon; History of New Place; and Outlines of the Life of Shakspere. He issued also forty-seven volumes of lithographed facsimiles of the quarto plays, and a great number of pamphlets on Shakspere, Stratford, and kindred topics. He also published a valuable Dictionary of Archaic and Provincial Words (1846).

HALL-MARK. See PLATE.

HALMSTAD, a seaport of Sweden, capital of the province of Halland, on the Cattegat, at the mouth of the Nissa. It has an old church and castle; cloth-making, brewing, salmon-fisheries, and a trade in deals, lumber, pitch. Pop. (1901), 15,567.

HALOPHYTES, a class of plants which inhabit salt marshes, and by combustion yield barilla, as *Salsola*, *Salicornia*, and *Chenopodium*.

HAMADRYAS. See BABOON.

HAMAMELIDACEÆ, the witch-hazels, a small natural order of epigynous exogenous trees or shrubs, varying in height from 6 to 30 feet. *Hamamelis virginica* yields the drug hazeline. See WITCH-HAZEL.

HAMERTON, PHILIP GILBERT, an English art critic, was born at Laneside, in Lancashire, on Sept. 10, 1834. He was educated at the grammar-schools of Burnley and Doncaster, and at first intended to proceed to Oxford. His taste for art, however, led him to abandon that intention, and for a time he studied landscape-painting, but deviated into literature, publishing a work on Heraldry in 1851, and in 1855 The Isles of Loch Awe and other poems. In 1859 Mr. Hamerton married a French lady, and thereafter resided chiefly at Autun, where he died on Nov. 5, 1894. He made himself well known to the English public as a writer on art in the Fine Arts Quarterly Review, the Fortnightly Review, the Saturday Review, and other periodicals. Amongst his works are: Thoughts about Art (1862), Etching and Etchers (1866); Contemporary French Painters (1867); Wenderholme (a novel, 1869); The Intellectual Life (1873); Round my House (1876); Marmorne (a novel, 1878); Modern Frenchmen (1878); Landscape (1885); French and English (1889); &c. In 1882 he was created an officer of the French Academy. He also wrote a French biography of J. M. W. Turner.

HAMILTON, the inland metropolis of the west-

ern district of Victoria, Australia, on the Grange Burn Creek, 197½ miles west of Melbourne, with which it is connected by railway. There are a number of hotels; hospital, town-hall, mechanics' institute, a college, government buildings, churches, and schools. The district is pastoral and agricultural. Pop. (1901), 4026.

HAMIRPUR, a town of India, in the United Provinces, capital of a district of the same name, situated on the right bank of the Jumna, at its confluence with the Betwa. Pop. (1891), 7081.

HANCHINOL, the Mexican name for *Heimia salicifolia*, a plant of the natural order Lythraceæ, which is a powerful sudorific and diuretic, and is much in repute as a cure for venereal diseases. The plant is an erect shrub, with willow-like leaves (hence the specific name) opposite below and alternate above. Its flowers are solitary in the axils of the leaves, and are very like those of the common Herb-twopence (*Lysimachia Nummularia*).

HAND-FISH. See CHEIRONECTES in SUPP.

HANOI, or KESHO, capital of Tonquin, on the river Song-ka, in a fruitful plain. Gold and silver filigree, lacquered wares, silks, mat and basket weaving are its principal industries. Although the river is navigable only for small vessels the trade of Hanoi is considerable, chiefly with the southern provinces of China. Pop. estimated from 80,000 to 150,000.

HANSI, town of Hissar district, Punjab, on the Western Jumna Canal. It was formerly a cantonment town, but is now of less importance. Pop. (1891), 15,190.

HAPUR, a town of India, in the Meerut district of the United Provinces. It has a considerable trade in sugar, grain, cotton, timber, &c. Pop. (1891), 14,977.

HARAR. See HARRAR in SUPP.

HARBOUR GRACE, a seaport of Newfoundland, on the west side of Conception Bay. It is the seat of a Roman Catholic bishop, and has a handsome cathedral and an active trade. Pop. 7000.

HARCOURT, SIR WILLIAM GEORGE GRANVILLE VENABLES VERNON, lawyer and politician, son of the Rev. William Vernon Harcourt, of Nuneham Park, Oxford, was born on Oct. 14, 1827. He was educated at Trinity College, Cambridge, where he graduated in 1851 with first-class honours in classics, being also one of the senior optimes in mathematics. He studied for the legal profession, and was called to the bar in 1854, becoming Queen's Counsel in 1866. In 1869 he was appointed Whewell professor of International Law at Cambridge, a post which he continued to hold till 1886. He early came forward as a politician, contributed frequently to the press, in particular the letters to the Times signed 'Historicus'; and was returned for Oxford city in 1868 in the Liberal interest. In parliament he soon distinguished himself in debate, especially by his powers of satire and ridicule, and he was made solicitor-general in Mr. Gladstone's ministry, Nov. 1873, resigning with his colleagues in the following year. In 1873 he was knighted. On Mr. Gladstone's return to power in 1880 he became home secretary, and a member of the privy council, but, failing to secure re-election for Oxford, he was returned for Derby. He introduced the Arms Bill (Ireland), 1881; the Prevention of Crimes Bill, 1882; and an Explosives Bill, 1883. In Feb. 1886 he became chancellor of the exchequer under Mr. Gladstone, whom he followed in his Irish policy; and he held the same office under the same leader, and subsequently under Lord Rosebery, in 1892–95, when a change of government took place. In his 1894 budget he introduced several important alterations on the death-duties and the income-tax. After Mr. Gladstone's retirement from political life in 1894 Sir William became leader of the Liberal party in the House of Commons. In recent years he has been prominent as an advocate of legislation intended to further temperance. At the general election of 1895 he lost his seat for Derby, but was returned for West Monmouthshire, and the same constituency again elected him their representative in 1900 by a large majority.

HARDA, a town of Hindustan, in the Central Provinces, on the Great Indian Peninsula Railway. Pop. (1891), 13,556.

HARD-FERN, the popular name for *Lomaria spicant*, which is also known as *Blechnum boreale* (or *spicant*). It is a very common fern, being found everywhere in Britain growing on heaths, in glens, on old roadside walls, and other places. It has simple pinnate fronds.

HARDOI, a town of India, administrative headquarters of Hardoi district, Oudh, 63 miles from Lucknow. It is of no special note apart from its civil status. Pop. (1891), 10,026.

HARDY, THOMAS, English novelist, was born in Dorsetshire on June 2, 1840, and received his earlier education at schools in his native county. He served an apprenticeship as an ecclesiastical architect, and practised and studied as such in London under Sir A. Blomfield. In 1863 he gained a prize and medal from the Institute of British Architects for an essay on 'Coloured Brick and Terra-cotta Architecture'; and in the same year he was awarded Sir W. Tite's prize for design. His art work, however, was definitely abandoned for literature, in which he attained a gratifying degree of success with his novel, Desperate Remedies, published in 1871. Since that date he has produced a series of novels which have placed him in the front rank of living writers of fiction. Their scenes are mostly placed in the Wessex country, whose scenery and people he portrays with great faithfulness and skill. His chief works are: Under the Greenwood Tree (1872); A Pair of Blue Eyes (1872–73); Far from the Madding Crowd (1874), his first great novel; The Hand of Ethelberta (1876); The Return of the Native (1878), one of his best works; The Trumpet Major (1879); A Laodicean (1880–81); Two on a Tower (1882); The Mayor of Casterbridge (1884–85); The Woodlanders (1886–87); Wessex Tales (1888), a series of short stories revealing great mastery in character-painting and considerable humour; A Group of Noble Dames (1891); Tess of the D'Urbervilles (1891); Life's Little Ironies (1894); Jude the Obscure (1895); and The Well-Beloved (1897). Mr. Hardy has alienated many of his earlier admirers by the bold realism of his later novels, particularly Tess and Jude the Obscure, which handle topics that many persons think fiction should be chary of touching, but these show the same vigour and the same power of description as his chief earlier works. In 1898 he issued a volume of poems under the title Wessex Poems.