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INDUSTRIAL GEOGRAPHY

by

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To

MY FATHER AND MOTHER

PREFACE

INDUSTRIAL geography is a division of the field of economic geography. Economic geography seeks to explain the relations existing between physical environment and the economic activities by which man earns his living, recognizing, of course, that, although physical factors are basic and set limits to human activity, the degree of completeness with which man utilizes his physical environment depends upon cultural factors, which have themselves evolved out of the complex of physical factors. Industrial geography, which might be called the geography of production, attempts to explain the preceding relations as they are reflected in the extractive, genetic, and manufacturing industries. Economic geography includes, in addition, the geography of commerce, which treats the principles and facilities by which commerce, or the exchange of commodities, is conducted. Different countries tend to produce those commodities which can be made with greatest advantage from particular combinations of the productive factors, and to exchange these commodities with each other. Industrial geography does not preclude the consideration of commerce; but, because we live in a world in which territorial specialization is fundamental, production presupposes commerce. Consequently emphasis is primarily on the production of goods rather than on their transfer after production, or on those economic activities which create elemental- and form-utility rather than on those which create place- and time-utility.

This book endeavors to give the physical basis and the economic principles underlying territorial specialization and to focus attention on the significant aspects of the industrial activities of the different countries. To do this, first, for each country, the different elements of the physical environment are summarized, along with some of the his-

torical results of their influence, to provide a background for the discussion of the industrial activities that follow. A feature of the treatment of the major industrial activities is an account—in greater detail for the United States than for other countries—of the methods and the economic organization by which each of the important raw and manufactured commodities is produced. There is also a brief mention of the industrial and consumer uses for these goods, which serves to indicate their industrial and economic importance. Next, is a brief summary of the products which the country exchanges with other countries, and, finally, there is a statement of the important economic problems with which the country is confronted.

A problem of growing importance, particularly for those highly industrialized nations with high standards of living, and a problem with political as well as economic implications, is that of the efficient utilization, or conservation, of declining supplies of natural resources. Because we live in an economically interdependent world, where growing populations and attempts to maintain or to raise standards of living accelerate the drain on the supplies of natural resources, it is important that citizens, statesmen, and businessmen should possess a knowledge of the problems that relate to the supplies and the utilization of these resources. For long, we in the United States were engaged in exploiting the abundant natural resources of a sparsely settled land. We could maintain a high standard of living and accumulate wealth in spite of our mistakes. But that day is passing; supplies of natural resources are being depleted and we are being forced to devise more efficient means for utilizing the remaining supplies. The study of such problems deserves an important place in modern education; its value is a continuing one after college years, and it has a significant place in the growing scheme of adult education, for only as one intelligently understands these matters is he qualified to pass opinions on the plans suggested for the solution of many of the problems now afflicting the nation and the world. Therefore, throughout this book whenever appropriate, attention is called to the necessity for conservation, to the measures that have already been devised for the more efficient utilization of natural resources, and to the problems awaiting solution. Although the analytical method of discussion is followed, some description is necessary for a subject of this nature.

Because of the educational value of graphic representation, a gener-

ous number of illustrations has been included. Photographs have been selected for their general educational value and to represent important features of the economic life of the respective countries. Graphs and charts have been used to make certain aspects of the discussion more vivid, and original maps have been used to show the features of the different countries that are important for the purposes of this book.

Although written primarily for college students, the material embodied here should have a cultural value for the citizen, or general reader, and much of practical value for businessmen and professional people. The book is adapted for text use in courses following the introductory course in the fundamentals of economic geography or, as is frequently the case in departments of economics and in small colleges, in a single course given to acquaint students with the natural resources and the industrial activities of the various countries. Industrial and professional organizations and departments of government which give courses in economics and business for training their help should also find this a useful text.

This book has been written after seventeen years of experience in teaching the subject. The knowledge and material embodied have therefore been gained from a variety of sources too numerous to make specific mention of each one. Acknowledgment is owed, however, to the various departments of government at Washington and to the Pan American Union, whose works have been used abundantly. The author wishes particularly to express his gratitude to Professor Nels A. Bengtson, Chairman of the Department of Geography of the University of Nebraska, for invaluable criticism concerning the general nature and organization of the book; to Dr. Charles E. Ward of the Department of English of Duke University, who read the entire manuscript for its English; to Mr. Claude L. McGonegal of the University of Nebraska, who did the drafting of the majority of the illustrations; and to Helen Landon for aid throughout the preparation of the manuscript. For any mistakes and shortcomings in the book the author alone is responsible.

CHARLES E. LANDON

CONTENTS

CHAPTER PAGE

PART ONE

The United States

GENERAL INTRODUCTION 1

Theme of this book. Influences other than those geographic. New England as an illustration. Accessory industries. Plan of this book. Plan of Part One. Plan of Part Two.

1. THE UNITED STATES FROM THE STANDPOINT OF REGIONAL INDUSTRIALISM 11

PHYSIOGRAPHIC FEATURES OF THE UNITED STATES (13): Natural divisions. The coastal plain. The Appalachian highlands. The interior plain. The western mountains and plateaus. FORESTS AND LUMBERING REGIONS (15): Extent of forests. Areas of exploitation. MINERAL REGIONS (18). AGRICULTURAL REGIONS (19): Importance of agriculture. Geography of agriculture. MANUFACTURING REGIONS (23): Distribution of manufactures. Reasons for importance of manufactures. POWER FACILITIES (25). TRANSPORTATION (25): Importance. Transportation routes. DISTRIBUTION OF ECONOMIC ACTIVITY (26).

2. FOREST RESOURCES AND THEIR INDUSTRIAL USES 30

Industrial functions of forests. Classes of wood. Uses of wood. Lumber used by manufacturing industries. Utilization of timber resources. Sources of waste. Reforestation. Forests and land utilization. The milling of lumber. Substitutes for lumber. PULP AND PAPER (39): Importance. Uses for paper in the United States. Kinds of pulp. Factors locating manufacture. Woods used for pulp and paper. Other paper-making materials. FURNITURE (41). NAVAL STORES (42): Nature and uses. Production. TANNING MATERIALS (44). FOREST WILD PLANT INDUSTRIES (45).

3. QUARRY PRODUCTS 47

Importance. Types of rock. Location of quarrying industries. THE STONE INDUSTRIES (49): Major divisions. Quarrying. Finishing operations. Granite. Basalt. Limestone. Marble. Sandstone. Slate. Soapstone. SAND AND GRAVEL (58). FELDSPAR (59). CLAY (60). FULLER'S EARTH (61). GYPSUM (61).

CHAPTER PAGE

4. THE IRON ORES AND THE FERRO-ALLOY MINERALS . 63

Groups. IRON ORES (63): Importance. Geological formation. Types of iron ore. Centers of production. Iron-ore reserves. THE FERRO-ALLOY MINERALS (66): Importance. Manganese. Nickel. Chromium. Vanadium. Tungsten. Molybdenum. Cobalt. Titanium. Uranium. Zirconium. Silica. Magnesite. Industrial importance of the ferro-alloys.

5. THE NONFERROUS MINERALS 74

A. METALLIC MINERALS (74) Copper. Lead. Zinc. Aluminum. Tin. THE PRECIOUS METALS (83) Gold and silver. Platinum. MERCURY AND ARSENIC (85): Mercury. Arsenic. B NONMETALLIC MINERALS (86). FERTILIZER MINERALS (86) Importance. Functions. Phosphorus. Potassium. Nitrogen. OTHER MINERALS (91): Mica. Graphite. Asbestos. Sulphur. SALT (95). COMMERCIAL MOVEMENT OF MINERALS (96).

6. POWER RESOURCES 98

Stages in power development. Energy position of the United States. Distribution of power resources in the United States. COAL (102): Advantages of coal as a fuel. Classes of coal. Reserves of coal. Major coal-producing areas Methods of mining coal. PETROLEUM (112): Nature and importance. Occurrence Classes of petroleum Reserves of petroleum Major petroleum-producing centers. Methods of production. The refining of petroleum. Location of refineries. The transportation of petroleum. Foreign commerce in petroleum products. OIL SHALES (121). NATURAL GAS (121): Occurrence. Uses. Reserves. WATER POWER (123): Requirements for water power. Water-power regions. EFFICIENT UTILIZATION OF POWER RESOURCES (125): Coal. Petroleum. Natural gas. Water power.

7. FISHERIES 130

Importance. Location of fisheries. Types of ocean fisheries. The control of ocean fisheries. Fisheries of the United States. Methods of the fishing industry. The fur seal.

8. THE CEREALS . . . 140

CORN (141): Importance. Uses. Natural requirements. Regions of production. Future of the corn belt. WHEAT (146): Qualities. Natural requirements. Classes of wheat. Regions of production. Foreign commerce in wheat. The future of wheat growing. OATS (152): Uses and qualities. Natural requirements. Types of oats. Regions of production. BARLEY (154): Uses. Natural requirements. Regions of production. RYE (156): Uses. Natural requirements. Regions of production. BUCKWHEAT (157): Uses. Natural requirements. Regions of production. SUMMARY (158): Commercial movements of cereals. Export trade in cereals other than wheat. Production of cereals.

9. HAY AND FORAGE CROPS 161

Distribution. The northeastern dairy region. The grain belt. The Southern States. The West. Commercial hay districts. PASTURES (169).

CHAPTER PAGE

10. VEGETABLE CROPS AND SOYBEANS 170

Importance of vegetables. Use in the United States. Types of vegetable farming. The winter-vegetable industry. The summer-vegetable industry. The New York-Norfolk area. Leading vegetables. POTATOES (178): Qualities. Geographic requirements. Regions of production. SWEET POTATOES (179). BEANS AND PEAS (180). THE SOYBEAN (182): Importance. Natural requirements. Uses.

11. FRUIT CROPS 185

Importance and use of fruits. Types of fruit. Natural requirements. Natural conditions in California. Economic factors. MIDDLE-LATITUDE TREE FRUITS (189). General distribution. Apples. Peaches. Apricots. Cherries Pears Plums. CITRUS FRUITS (192): Importance. Location Other tropical fruits. GRAPES (197). Types and location. BUSH FRUITS (199): Influences controlling production. Uses of bush fruits. Centers of production. SUMMARY (201): The home orchard Markets for fruit.

12. NUT CROPS 203

Qualities Problems of nut growing. Regions of production. Persian walnuts Almonds. Pecans. Filberts. Pine nuts. Other nuts. The tung tree. PEANUTS (209): Qualities. Natural requirements. Uses. Regions of production. SUMMARY (210): Outlook for nut crops. Import trade in tree nuts.

13. SUGAR CROPS 213

Sources of sugar. THE SUGAR BEET (214): Requirements. Areas of production. SUGAR CANE (217): Requirements. Areas of production. Import trade in sugar. HONEY (221): Uses. Requirements. Regions of production. OTHER SUGAR CROPS (223): Sorghum cane. Maple products. Corn.

14. TOBACCO 224

Early history. Varieties. Environmental requirements. The growing of tobacco. Regions of production and types. The manufacture of tobacco products. The auction warehouse.. Foreign commerce in tobacco.

15. TEXTILE FIBERS 236

COTTON (236): Uses. Importance of the United States. The cotton belt. Natural requirements of cotton. The boll weevil. Methods of production. One-crop agriculture. Manufactures of cotton. A price-control system for cotton. Foreign commerce in cotton. HEMP (248). WOOL (250): Nature and importance. Types of sheep. Classes of wool. The United States as a wool producer. Imports of wool. MOHAIR (253).

16. THE ANIMAL INDUSTRIES 255

BEEF PRODUCTION (255): Importance of meats. Desirability of cattle. Breeds of beef cattle. Factors affecting the distribution of beef cattle. Regions of production. DAIRY PRODUCTS (259): The efficiency of dairying. Requirements of dairying. Breeds of dairy cattle. Types of dairy farming. Regions of production. SWINE (262): Desirability of swine. Factors controlling the distribution of swine. Types of swine. Breeds of swine. Regions of production. SHEEP (264): Factors controlling distribution. Regions

CHAPTER PAGE

16. THE ANIMAL INDUSTRIES (*Cont.*)

of production. GOATS (267). HORSES AND MULES (268): Requirements of a good draft animal. POULTRY PRODUCTS (270): The efficiency of poultry. Influences locating poultry production. Types of poultry industry. Regions of production. Poultry packing. FOREIGN COMMERCE IN ANIMAL PRODUCTS (273).

17. IRON AND STEEL 274

Rise of iron and steel industry in the United States. Divisions of the industry. Transporting the iron ore. Stages in the manufacture of iron and steel. Use of water. Organization of steel manufacturing. Location of iron and steel factories. Steel centers and their products. By-products. Foreign commerce in iron and steel products.

18. TEXTILES 291

Distribution of manufacture. The manufacturing processes. COTTON (293): Manufacturing operations. Centers of manufacture. WOOL (298): Manufacturing operations. Centers of manufacture. SILK (300): Growth of silk manufacture. Manufacturing operations. Centers of manufacture. RAYON (302): Nature. Uses. Processes and raw materials. Location of the industry. MANUFACTURE OF WEARING APPAREL (304): Nature of the industry. Location. IMPORTANCE OF THE TEXTILE INDUSTRY (305): Foreign commerce in textile products.

19. FOOD MANUFACTURES 307

MEAT PACKING (307): History. Organization of meat packing. By-products. Organization of a meat-packing plant. Location of meat-packing plants. THE MANUFACTURE OF CEREALS (311): Divisions of cereal manufacture. Flour milling. Organization of flour milling. Location of flour mills. Flour milling and freight rates. The milling of other cereals. Bakery products. Breakfast foods. THE CANNING INDUSTRY (315): History. Economic importance of food preservation. Organization. Canning centers. DRIED FOODS (318): The drying of fruits and vegetables. SUGAR REFINING (318): Nature of processes. Location of refineries. By-products. DAIRY PRODUCTS (320): Products made. Location of manufacture. FOREIGN COMMERCE IN FOOD PRODUCTS (322).

20. CHEMICAL INDUSTRIES . . 324

Chemistry in industry. The services of chemistry. Chemical industries. Requirements for successful chemical industries. Chemical raw materials. Development in the United States. American contributions in industrial chemistry. Organization of chemical manufacture. Location of chemical manufacture. Electrochemical products. Sulphuric acid. Alkali. Alcohol. Coal tar. Cellulose. Foreign commerce in chemical products.

21. TRANSPORTATION EQUIPMENT 337

Features of transportation equipment industries. RAILWAY EQUIPMENT (338): Types. Centers of manufacture. AUTOMOTIVE EQUIPMENT (339): Importance. Reasons for low unit costs. Organization of automotive manufacture. Centers of manufacture. AIRCRAFT (342): Rise of air trans-

CHAPTER PAGE

21. TRANSPORTATION EQUIPMENT (*Cont.*)

portation. Centers of manufacture. SHIPBUILDING (343): Historical influences. Location of shipyards. EXPORT TRADE IN TRANSPORTATION EQUIPMENT (346).

22. ELECTRICITY 348

Expansion of use of electricity. Advantages versus disadvantages. The sources of electricity. Steam versus hydroelectric power. Internal-combustion motors. Organization of the electrical industry. The manufacture of electrical equipment. GIANT POWER (355): Meaning and implications. Advantages. An example of giant power. The national power development program.

23. ALASKA AND THE PACIFIC POSSESSIONS OF THE UNITED STATES 360

ALASKA (361): Retarded development. Natural divisions and features. Forests. Minerals. Fisheries. Furs and trapping. Grazing. Agriculture. The Matanuska Valley. Foreign commerce. HAWAII (367): Features. People. Cane sugar. Pineapples. Foreign commerce. OTHER ISLANDS (369).

PART TWO

Foreign Countries

INTRODUCTION 373

24. CANADA 375

Canada and the United States. Natural regions. Forests. Minerals. Water power. Fisheries. Furs. AGRICULTURE (384): Nature. Cereals. Foreign trade in wheat. Other crops. Animal industries. MANUFACTURING (388): Importance. Pulp and paper. FOREIGN COMMERCE (392).

25. THE BRITISH ISLES 396

Reasons for Britain's rise. Area and population. Geographic features. Climate. Fisheries. Minerals. Agriculture. Crops. Animal industries. Manufactures. Textiles. Iron and steel. Chemicals. Other manufactures. Foreign commerce.

26. BRITISH AFRICA 412

BRITISH SOUTH AFRICA (412): Geographic features. Climate. Minerals. Agriculture. Crops. Animal industries. Manufacturing. Transportation. Foreign commerce. BRITISH WEST AFRICA (420): Importance. Geographic features. Diseases. Crops. Minerals. Transportation. Foreign commerce. BRITISH EAST AFRICA (422): Geographic features. Climate. Forests. Crops. Transportation. Foreign commerce. THE ANGLO-EGYPTIAN SUDAN (425): Geographic features. Products. Transportation. Foreign commerce. SIGNIFICANCE OF POSSESSIONS TO THE BRITISH (428).

27. FRANCE 429

Area and population. Reasons for importance of France. Geographic features. Climate. Forests. Minerals. Water power. Fisheries. Agriculture.

CHAPTER PAGE

27. FRANCE (*Cont.*)

Crops. The grape-growing industry. Animal industries. Manufactures. Foreign commerce. FRENCH AFRICA (441): Importance. THE ATLAS COUNTRIES (442): Geographic features. Minerals. Fisheries. Agriculture. Animal industries. THE SAHARA DESERT (444). FRENCH WEST AFRICA (446): Geographic features. FRENCH SOMALILAND (447). FRENCH EQUATORIAL AFRICA (448). MADAGASCAR AND NEAR-BY ISLANDS (448). SIGNIFICANCE OF POSSESSIONS TO FRANCE (448).

28. THE IBERIAN PENINSULA 450

Geographic features. Climate. Forests. Cork oak. Minerals. Water power. Fisheries. Agriculture. Crops. Animal industries. Manufactures. Foreign commerce. Atlantic islands. SPANISH AFRICA (459): Divisions. Resources and industries. PORTUGUESE AFRICA (459): Divisions. Resources and industries British interest in Portuguese colonies.

29. ITALY 462

Factors in the development of Italy. Geographic features. Climate. Minerals. Agriculture. Crops. Animal industries Manufactures. Foreign commerce. ITALIAN AFRICA (470): Divisions. Libya. Eritrea and Italian Somaliland. Ethiopia. Significance of colonies.

30. THE THREE SMALL EMPIRE COUNTRIES OF NORTHWESTERN EUROPE 474

Common features. Area and population BELGIUM (475): Geographic features. Minerals. Agriculture. Manufactures. Foreign commerce. BELGIAN INTERESTS IN AFRICA (478): Geographic features. Products Transportation. Foreign commerce. THE NETHERLANDS (479): Geographic features. Minerals. Agriculture. Manufactures Foreign commerce The Netherlands colonial possessions. DENMARK (483): Geographic features. Agriculture. Manufactures. Foreign commerce. GREENLAND AND ICELAND (486): Greenland. Iceland. ECONOMIC NATIONALISM AND THE SMALL EMPIRE COUNTRIES (487).

31. THE SCANDINAVIAN PENINSULA 488

Geographic features. Climate. NORWAY (491): Forests. Minerals. Water power. Fisheries. The whaling industry. Agriculture. Manufactures. Foreign commerce. SWEDEN (495): Forests. Water power. Minerals. Agriculture. Manufactures. Foreign commerce. Economic problems of Norway and Sweden.

32. THE GERMAN REICH 499

Factors in development. Geographic features. Climate. Forests. Minerals. Water power. Agriculture. Crops. Animal industries. Manufacturing. Waterways. Foreign commerce. Germany's industrial and commercial problems.

33. POLAND AND THE CONTINENTAL BALTIC STATES 516

Historical factors. POLAND (516): Area and population. Geographic features. Climate. Forests. Minerals. Agriculture. Manufactures. Foreign commerce. FINLAND (522): Geographic features. Climate. Natural resources. Agriculture. Manufactures. Foreign commerce. ESTONIA, LAT-

CHAPTER PAGE

33. Poland and the Continental Baltic States (*Cont.*)

via, Lithuania (524). Geographic features. Climate. Natural resources. Agriculture Manufactures Foreign commerce. Future of these countries.

34. The Highland Countries of Central Europe 528

Switzerland (528). Geographic features. Forests. Minerals. Water power. Agriculture: Grazing Manufactures. The tourist industry. Foreign commerce. Bohemia, Moravia, and Slovakia (535). Agriculture. Manufactures. Foreign commerce

35. The Agricultural Countries of Southeastern Europe 538

Historical factors. Area and population Geographic features Climate. The Danube Forests. Minerals Agriculture. Hungary (544): Agriculture. Manufactures. Exports. Rumania (545) Agriculture. Manufactures. Exports Bulgaria (546) Agriculture Manufactures. Exports. Yugoslavia (547): Agriculture Manufactures Exports. Albania (548). Greece (549). Agriculture Manufactures. Exports. European Turkey (550). Foreign Commerce (552). Conclusions.

36. Egypt and the Near East 554

Area and population. Egypt (555): The Nile Irrigation. Foreign commerce. The Suez Canal Palestine and Syria (558). Natural resources and industries Transportation Foreign commerce. Turkey (560): Natural resources and industries Plans for economic progress. Foreign commerce Iraq (562) Arabia (563). Iran (564). Afghanistan (566). Summary (566)

37. Union of Soviet Socialist Republics 567

Reasons for backwardness. Geographic features. Climate. The tundra. Forests. Trapping. Minerals. Water power Agriculture. Crops. Animal industries. Manufactures Foreign commerce. Conclusions.

38. The Japanese Empire and Manchukuo 584

Divisions and population. Factors in progress. Geographic features. Climate. Forests. Minerals. Fisheries. Agriculture. Crops. Silk. Manufactures. Foreign commerce. Chosen (596). Formosa (596). Manchukuo (597): Control. Geographic features. Climate. Forests. Minerals. Agriculture. Conclusions (599).

39. The Chinese Empire 601

Area and population. Lack of progress. Geographic features. Climate. Minerals. Agriculture. Crops. Animals. Manufactures. Foreign commerce. The Outer Provinces (615). China and Her Neighbors (617).

40. The Indian Empire 619

Area and population. Geographic features. Climate. Forests. Minerals. Agriculture. Tea. Animals. Manufactures. Foreign commerce. Economic problems of India.

CHAPTER PAGE

41. SOUTHEASTERN ASIA, THE EAST INDIES, AND THE PHILIPPINE ISLANDS 632

Area and population. Geographic features. Climate. Forests. Minerals. Agriculture. Field crops. Tree crops. Other crops. Foreign commerce. Importance of British possessions. Netherland India and the mother country. The Philippines and the United States.

42. AUSTRALIA AND NEW ZEALAND 648

AUSTRALIA (648): Geographic features. Climate. Forests. Fisheries. Minerals. Water power. Pastoral industries. Crops Irrigation. Manufacturing. Transportation. Foreign commerce. NEW ZEALAND (662): Geographic features. Climate. Pastoral industries. Kauri gum. Foreign commerce.

43. SOUTH AMERICA: THE WEST-COAST COUNTRIES 666

SOUTH AMERICA: THE CONTINENT (666): Retarded development. Geographic features. Climate. THE WEST-COAST COUNTRIES (670): Area and population. Isolation. CHILE (670): Geographic features. Climate. Forests. Minerals. Water power. Agriculture. Crops. Animal industries. Manufacturing. Transportation. Foreign commerce. PERU (678): Geographic features. Minerals. Agriculture. Crops. Animal industries. Transportation. Foreign commerce. BOLIVIA (685): Geographic features. Minerals. Agriculture. Coca. Transportation. Foreign commerce. ECUADOR (687): Geographic features. Minerals. Crops. Ivory nuts. Panama hats. Transportation. Foreign commerce.

44. THE EAST-COAST COUNTRIES 691

Area and population. The Plata River system. ARGENTINA (693): Geographic features. Climate. Large estates. Agriculture. Crops. Animal industries. Minerals. Manufacturing. Quebracho. Transportation. Foreign commerce. URUGUAY (703): Climate. Agricultural products. Manufactures. Transportation. Foreign commerce. PARAGUAY (705): Backwardness. Geographic features. Climate. Industries. Yerba maté. Foreign commerce. BRAZIL (707): Geographic features. Climate. Forest products. Minerals. Water power. Agriculture. Crops. Animal industries. Manufactures. Transportation. Foreign commerce. A future great region?

45. THE NORTH-COAST COUNTRIES 721

THE GUIANAS (721): Geographic features. Natural resources and industries. VENEZUELA (724): Minerals. Coffee. Cacao. The Orinoco basin. Foreign commerce. COLOMBIA (726): Minerals. Coffee. Bananas. Foreign commerce.

46. THE ISLAND REPUBLICS AND COLONIES 728

Area and population. Factors in progress. Geographic features. Climate. Minerals. Fisheries. CROPS OF THE WEST INDIES (731): Sugar cane. Cuban sugar-cane industry. Coffee. Cacao. Coconuts. Fruits and vegetables. Other crops. FOREIGN COMMERCE (738). THE BERMUDAS (740).

47. THE CENTRAL AMERICAN COUNTRIES 741

Geographic features. Forests. Minerals. Water power. Bananas. Coffee. Other crops. Animal industries. Transportation. Foreign commerce. Summary.

CHAPTER PAGE

48. MEXICO 750

Area and population. Geographic features. Climate. Forests. Chicle. Minerals. Agriculture. Crops. Animal industries. Manufacturing. Transportation. Foreign commerce. Future of Mexico.

49. FOREIGN COMMERCE 763

Trade routes. Basis of foreign commerce. Advantages of foreign commerce. Government control and aid of foreign commerce. Economic nationalism. Economic nationalism and the United States.

BIBLIOGRAPHY 773

INDEX 783

MAPS AND ILLUSTRATIONS

[Photographs are in italics]

FIGURE		PAGE
1.	Land relief of the United States	12
2.	Lumber regions of the United States	16
3.	Forest resources of the United States, total stand including saw-timber areas, cordwood areas, and restocking areas, by regions	17
4.	Rank of states in minerals	18
5.	The position of countries in minerals	19
6.	Map of agricultural regions	20
7.	Manufacturing regions of the United States	21
8.	Leading manufacturing industries of the United States in 1935 according to the value added by manufacture, with the wages and salaries paid by each industry	23
9.	Ton-miles of freight hauled by the different agencies of transportation	24
10.	Rail routes and waterways, United States	25
11.	Distribution of the gainfully employed	26
12.	Distribution of the average annual income of the United States, 1934-36, among the different industrial divisions	27
13.	Per capita retail sales of the different states in 1935	28
14.	Lumber contributed by various species of trees in the United States	31
15.	*Results of destructive logging and repeated fires on slopes of Mount Mitchell, Pisgah National Forest, North Carolina*	34
16.	What becomes of wood	35
17.	Possible increase in annual forest growth by improved practice	37
18.	Relative importance of the different uses of granite in the United States in 1936	52
19.	Relative importance of the different uses of basalt in the United States in 1936	53
20.	Relative importance of the different uses of limestone in the United States in 1936	53
21.	Map showing principal limestone areas in the United States east of the Rocky Mountains	54
22.	*Channeling machines at work in Indiana limestone quarry, Bedford, Indiana*	55
23.	Relative importance of the different uses of marble in the United States in 1936	56
24.	Relative importance of the different uses of sandstone in the United States in 1936	57
25.	Relative importance of the different uses of slate in the United States in 1936	57
26.	*View of Hull-Rust Mine near Hibbing, Minnesota*	65
27.	Principal uses of copper in the United States in 1936	75
28.	Leading states in the production of copper from domestic ores in the United States in 1936	75

FIGURE		PAGE
29.	*Removing fine copper cathodes from solution*	76
30.	*General view of converter floor in a copper refinery*	78
31.	Principal uses of lead in the United States in 1936	79
32.	Leading states in the production of recoverable lead in 1936	80
33.	*Open-pit mining of bauxite in Arkansas*	82
34.	Losses of plant nutrients from the soil	87
35.	Sulphur mining	94
36.	Efficiency of different types of engines	100
37.	Relative position of the United States in power resources and their production	101
38.	Regional distribution of the coal reserves of the United States	102
39.	Uses of coal	103
40.	Relative rank of energy resources	104
41.	Distribution of coal reserves of the United States among the different classes of coal	105
42.	Coal provinces of the United States	105
43.	Leading states in reserves of bituminous coal	106
44.	Average annual production of coal of the leading states, 1934-36	107
45.	Room-and-pillar method of mining Pittsburgh coal bed	109
46.	Long-wall method of mining coal	110
47.	Distribution of crude petroleum production of the United States among the principal refined products—average, 1934-36	112
48.	Showing how oil is trapped underground by an anticline and by a fault	113
49.	Map of the oil provinces and the principal pipe lines of the United States	115
50.	Leading states in the production of crude petroleum in 1936	116
51.	Leading states in the production of marketable natural gas in 1936	122
52.	Regional distribution of potential water power of the United States	123
53.	Regional distribution of developed water power in the United States in 1936	124
54.	Declining use of coal	125
55.	Coal by-products	126
56.	Fishing banks and principal fishing ports of northeastern North America	134
57.	Relative importance of the different canned fish in the United States and Alaska in 1936	136
58.	*Steam trawler used in fisheries in North Atlantic*	137
59.	*Men throwing net overboard, fish on deck are almost exclusively cod*	138
60.	Principal crops: acreage, 1879-1936	141
61.	Relative importance of the different uses of corn	142
62.	*Four-row corn cultivator on Illinois farm*	145
63.	*Harvester-thresher at work on the contour on a terraced wheat field in Kansas*	149
64.	Principal oats- and rye-producing areas of the United States	153
65.	Principal barley-producing areas of the Plains region	155
66.	The hay-producing regions and distribution of hay production in the United States	162
67.	Principal sorghum-growing area of the United States	165
68.	*Typical head of Red Kaffir corn*	166
69.	Relative importance of the different crops of the United States according to value in 1936	167
70.	Carrying capacity of pasture and range land	168
71.	Seventeen vegetables for fresh market shipment: indexes of acreage, yields, price, and value, 1919-1937	171
72.	*Garden tractors cultivating spinach*	173

FIGURE		PAGE
73.	Relative farm values of the principal commercial truck crops of the United States in 1936	177
74.	Relative farm values of the principal commercial fruit crops of the United States in 1936	186
75.	Land in fruit orchards, vineyards, and planted nut trees, acreage, 1929	189
76.	*Orange groves and snowy peaks near Los Angeles*	193
77.	*Dewberry fields in sandhill district, North Carolina*	199
78.	Relative importance of principal unshelled tree nuts in the United States in quantity produced, average for 1935-37	204
79.	*Tung-tree orchard in Mississippi in foreground, pine forest in background*	208
80.	*Peanuts stacked for curing*	211
81.	*Sugar beets*	215
82.	Rank of the principal sugar-producing states in the quantity of domestic raw sugar produced in 1936	218
83.	Sugar, cane and beet: United States production, imports (duty paid), and receipts from insular possessions, 1910 to 1937	220
84.	*Field of bright-yellow tobacco (flue-cured) in North Carolina*	225
85.	*Tobacco-curing barn in North Carolina*	228
86.	Tobacco-growing districts	229
87.	Tobacco products: consumption per capita in the United States	230
88.	*Selling scene in tobacco auction warehouse*	234
89.	Areas of heaviest cotton production	238
90.	*Cotton-picking scene*	242
91.	Value of farm real estate per acre, January 1, 1935	244
92.	United States cotton exports by countries, 1925-26 to 1936	247
93.	Cotton production: United States, foreign countries, and world, 1890 to 1935	248
94.	*Two types of hemp plant*	249
95.	Wool-producing areas of the United States; wool produced in 1929	253
96.	Beef cattle (excluding calves and bulls); number on farms and ranges, April 1, 1930	257
97.	Milk produced on farms	261
98.	Swine on farms; number, April 1, 1930	264
99.	*A merino sheep*	266
100.	*Sheep of the mutton type on an Illinois farm*	266
101.	Horses, mules, and colts of all ages	269
102.	Eggs, production, 1934	272
103.	Per capita use of steel	275
104.	*Ore boat loading from pockets of pier at Duluth*	277
105.	*Blast furnaces at Birmingham, Alabama*	279
106.	How the blast furnace operates	280
107.	*Pig-casting machine*	281
108.	*Charging open-hearth furnace*	282
109.	*Pouring molten steel into ingot molds*	283
110.	*Rolling of ingots*	284
111.	Leading uses for steel in the United States in 1936	285
112.	Map of steel plants	286
113.	Consumption of cotton, wool, silk, and rayon, United States, 1920-21 to 1936	292
114.	*View of card room showing cotton being processed*	294
115.	*Spinning room in a cotton mill*	295
116.	*Weaving room of a cotton mill*	296
117.	*Yarn being run through dyeing vats and carried up on skiers for oxidation*	297

FIGURE		PAGE
118.	Regional distribution of active cotton spindles in the United States	298
119.	Principal meat-packing and flour-milling centers of the United States	309
120.	Principal fruits and vegetables canned in the United States in 1935	317
121.	Ice cream: United States factory production	322
122.	Principal uses for sulphuric acid in the United States in 1936	330
123.	Uses of salt	331
124.	Flow chart of electrolytic operations in manufacturing alkalies	332
125.	*Chemical processes in the manufacture of photographic film, and some applications*	335
126.	*Modern locomotive suitable for either fast freight or heavy passenger service*	339
127.	*Administration Building, Municipal Airport, Wichita, Kansas*	342
128.	*Ship under construction*	345
129.	Regional distribution of electricity made from all sources in the United States	348
130.	Approximate location of electric generating stations of a capacity of 25,000 kilowatts or more and of transmission lines of a capacity of 100,000 volts or more	351
131.	Potential and developed water-power energy at selected sites in the United States	357
132.	Federal Power Projects	358
133.	Island possessions of the United States in the Pacific	361
134.	Alaska	362
135.	*Herd of reindeer, Alaska*	365
136.	*Pineapple plantation, Island of Oahu*	368
137.	Natural regions of Canada	377
138.	*Salmon fishing fleet starting out*	382
139.	*A fish cannery on the fiorded coast of British Columbia*	383
140.	*Fox ranches near Summerside, Prince Edward Island*	384
141.	*Cattle ranch in Alberta*	387
142.	Leading Canadian manufacturing industries in value added by manufacture, 1935	389
143.	*Paper mill, Kapuskaking, Ontario*	390
144.	Pulp and paper manufacturing centers of Canada	391
145.	Principal items in the foreign commerce of Canada in 1935	393
146.	*Grain elevator and docks at Fort Churchill, Manitoba*	394
147.	The British Isles, showing the location of the leading cities and principal coal fields of Great Britain	400
148.	Principal items in the foreign commerce of the United Kingdom, 1936	410
149.	Invisible items of British trade in 1935	411
150.	Political divisions and the location of the principal railroads and cities of Africa south of the Equator	413
151.	Natural regions of British South Africa	414
152.	Principal animal-producing areas of the Union of South Africa	417
153.	Principal imports of British South Africa in 1935	419
154.	Distribution of tsetse flies	421
155.	Principal exports of British East Africa in 1935	425
156.	The Nile region and the horn of Africa	426
157.	Principal exports of the Anglo-Egyptian Sudan in 1935	427
158.	France	431
159.	Mean monthly temperatures of Bordeaux and Nancy	433
160.	Relative amounts of land in crops occupied by different crops in France in 1936	436
161.	Chart of the wine districts	437
162.	Principal items in the foreign trade of France, 1936	441

FIGURE		PAGE
163.	*Olive orchard in Tunis*	443
164.	Principal exports of the Atlas countries in 1935	444
165.	*An oasis in the Sahara*	445
166.	Bus routes across the Sahara Desert	447
167.	The Iberian Peninsula	451
168.	Regions producing citrus fruit in Spain	455
169.	Regions of olive production in Europe and Algeria	456
170.	Italy	463
171.	Mean monthly temperatures and monthly rainfall of Milan and Minneapolis	465
172.	Acreage of principal crops of Italy in 1935	467
173.	Principal items in the foreign commerce of Italy in 1936	470
174	Belgium and The Netherlands	475
175	Principal cheese-exporting countries in 1935	481
176	Denmark, the Island of Bornholm in inset	483
177	Principal butter-exporting countries in 1935	484
178	The Scandinavian Peninsula	489
179	Mean monthly temperatures of Stockholm and Bergen	490
180.	Exports of forest products from the principal exporting countries in 1935	496
181	The German Reich	501
182	*Working in fields in German highlands*	505
183.	*The hay harvest in the Urstromtäler of the Netze in the plain of eastern Germany*	507
184	Relative acreages of principal crops of Germany in 1936	508
185	*Locomotive works at Hanover*	509
186	Principal items in the foreign commerce of Germany in 1936	514
187.	Poland and East Prussia	517
188	Principal items in the foreign commerce of Poland in 1935	520
189	Finland, with the principal lakes, cities, and railroads	522
190.	The three small Baltic states with the principal cities and railroads	524
191.	Natural divisions and leading cities of Switzerland	529
192.	Principal items in the foreign commerce of Switzerland in 1935	533
193.	Bohemia, Moravia, and Slovakia	534
194.	Principal exports of Czecho-Slovakia in 1935	536
195.	Relative values of the imports of Czecho-Slovakia (boundaries as of 1937) in 1936	537
196	Southeastern Europe	539
197.	Mean monthly temperatures and monthly rainfall of Budapest and Berlin	541
198.	Acreages in the principal crops of the countries of Southeastern Europe in 1935	543
199.	Numbers of various animals in the countries of southeastern Europe in 1935	544
200.	Distribution of the foreign commerce of the countries of Southeastern Europe in 1935	551
201.	Political divisions and principal cities and railroads of the Near East	555
202.	The Union of Soviet Socialist Republics	569
203.	*Summer sledging in the tundra near Golchikha*	572
204.	Acreages in principal crops of the U.S.S.R. in 1935	576
205.	Numbers of different kinds of animals in the U.S.S.R. in 1936	580
206a.	Principal imports of the U.S.S.R. in 1935	582
206b.	Principal exports of the U.S.S.R. in 1935	582
207.	The Japanese Empire and Manchukuo	585
208.	Annual rainfall of Japan and Taiwan and the January isotherm of 32° and the July isotherm of 68° in Japan	587
209.	*Mulberry trees*	593
210.	Production of cotton yarn and exports of cotton cloth in Japan	594

FIGURE		PAGE
211.	Principal items in the foreign commerce of Japan in 1935	595
212.	Chinese Empire	602
213.	*In the loess country in western Honan*	604
214.	*Coal fields of Southwestern Asia*	606
215.	Natural divisions and leading cities of the Indian Empire	620
216 (a and b).	Principal producing areas of the leading crops of India	626
217.	Regions of tea production in India and Ceylon	628
218.	Principal items in the foreign commerce of British India, 1936	630
219.	Southeastern Asia, the East Indies, and the Philippine Islands	633
220.	Area and population per square mile of the main divisions of Southeastern Asia and the East Indies and of the Philippine Islands	634
221	Mean monthly rainfall of Batavia and Singapore	635
222.	Acreage and production of rice in the leading producing countries in 1934	636
223	*Rubber trees being tapped in Sumatra*	640
224.	*Coconut tree with one hundred coconuts on it, Mindanao, Philippine Islands*	641
225	*Coconut market on the Pagsanjan River, Laguna Province, Philippine Islands*	642
226	Volume of exports and imports of the different political divisions in 1935	644
227	Relative positions of the leading exports of Southeastern Asia, the East Indies, and the Philippine Islands in 1935	645
228	Principal imports of Southeastern Asia, the East Indies, and the Philippine Islands in 1935	646
229	The Commonwealth of Australia; Tasmania in inset	649
230.	*Fruit on drying racks, Mildura, Victoria*	658
231	Principal imports of Australia in 1935	661
232.	*View of Sydney Harbor*	662
233.	The Dominion of New Zealand	663
234	Climate of South America	669
235.	Chile, between 25° south latitude and Puerto Montt, with principal cities and railroads	671
236.	The leading cities and railroads of southern Peru, Bolivia, and northern Chile	672
237a.	Monthly rainfall for Santiago and Valdivia	673
237b.	Mean monthly temperature for Santiago and Valdivia	673
238	Principal items in the foreign commerce of Chile in 1935	677
239.	Principal rivers and cities and the important transverse rivers of Peru	678
240.	*Peru: llamas in the village of Pangoa, high in the mountains*	682
241.	*Peru: long-haired alpacas*	683
242.	Principal items in the foreign commerce of Peru in 1935	684
243.	Percentage of total volume of exports contributed by each west-coast country	686
244.	*Cacao trees in bearing*	688
245.	Principal items in the foreign commerce of Ecuador in 1935	689
246.	Argentina, Uruguay, and Paraguay	692
247.	Crop- and animal-producing districts of Argentina	694
248a.	Principal exports of Argentina in 1935	703
248b.	Principal imports of Argentina in 1935	703
249.	Leading cities and railways and the coffee-growing district of Brazil	708
250.	Monthly rainfall and mean monthly temperatures for selected stations in Brazil	709
251.	***Brazil: a coffee plantation in the State of São Paulo***	714
252.	***Brazil: view of the railway which runs between Santos and the City of São Paulo***	717
253.	Principal imports of Brazil in 1935	719
254.	The north-coast countries of South America	722

FIGURE		PAGE
255.	Principal items in the foreign commerce of Colombia in 1935	727
256.	Island republics and colonies of the West Indies	729
257.	Estimated American investments in Cuba in 1933	730
258.	*Cultivating sugar cane on a plantation in Cuba*	732
259.	*Crushing sugar cane in a* central	733
260.	Volume of foreign commerce of the West Indies, Mexico, and Central America in 1935	739
261.	Principal exports of Puerto Rico to the United States in 1935	739
262.	Distribution of their total foreign commerce among the island republics and colonies of the West Indies in 1935	739
263.	Central America	742
264.	*View of banana plantation*	744
265.	The trends of the imports of coffee and bananas into the United States from selected countries for year ending June 30	745
266.	*Indians carrying pottery and firewood to market near Tegucigalpa, Honduras*	748
267.	Mexico	752
268.	Foreign investments in Mexico in 1930	755
269.	*Canal in the national system of irrigation of Mexico*	756
270.	*Mexico: general view of the San Rafael Paper Mills, in the State of Mexico*	759
271.	World's principal ocean routes	764
272.	Proportion of the total foreign commerce of the world shared by the leading commercial nations in 1936	768
273.	Principal exports of the United States in 1936	769
274.	Principal imports of the United States in 1936	770
275.	United States markets	771

EDITOR'S INTRODUCTION

A STUDY of the natural resources, the industries that convert them into active use, and the products made available through industrial processes is surely in keeping with the times in which we live. *Industrial Geography* may thus be interpreted as applied economic geography. The rapid changes which have marked the industrial development of the recent past and which are still in progress necessitate continuing re-evaluation of the economic resources, the processes of manufacture, and the variety of products that characterize the industries of the various regions and countries of the world today.

In addition to providing an aid to college students in their quest for a reliable, current appraisal of the industrial realm and to businessmen in viewing broadly the important phases of industrial progress, the author has included a wealth of factual material so organized as to be of great value for reference purposes. The statistical data have been selected with care and have been compiled with zealous regard for accuracy and timeliness. Praiseworthy as that is—and the author deserves to be complimented highly for his efforts in this field—the greater good served by this book will come from the broad truths and philosophies developed through the use of the factual data. The presentation throughout emphasizes the realities with which industrial progress is concerned and which underlie the problems to be faced. The development of fundamental principles grows out of concrete application of facts to the various phases of the problems of production, manufacture, and trade.

During recent years there has developed in the United States a keen appreciation of the necessity for conservation of resources. Conservation implies right use, not lack of use, of the resources with which a state or country is endowed. We believe that geography offers the

logical, even the expected, channel for arousing college students to a realization that conservation must be practiced if the basis for permanent prosperity is to be preserved. Guided by a firm belief in the soundness of this philosophy, the author has presented pertinent facts bearing on the conservation of material and human resources. It is hoped that teachers, students, and general readers will be aided in their understanding of the present movement by the textual data and discussions included within the several chapters. The importance of conservation to the permanent welfare of society justifies the emphasis here given.

It has become almost a custom to think of the present as the "machine age" and to place the responsibility for economic adversity upon the machine. Although widely quoted, we believe such current views to be in error. The present should be viewed, rather, as the age of "men and machines," and let man be first in assuming responsibility for either the success or failure of present movements. The role of man in the realm of industrial progress is here emphasized. The human element is ever in the foreground, whether the treatment is carried out in detail as for our own country or in bold but forceful résumé as must be the case for the various foreign lands.

This book is presented as a member of the Geography Series with faith that it will be well received. We believe that it will prove to be a worthy contribution to the rapidly growing list of commendable treatises in the field of college geography and that it will be welcomed by a large number of colleges and universities looking for a text wherein the treatment is presented on an industrial basis for the major countries of the world.

NELS A. BENGTSON

INDUSTRIAL GEOGRAPHY

GENERAL INTRODUCTION

Theme of this book. The main purpose of this book is to bring into sharp relief the relationship existing between the major elements of the physical environment—location, climate, land forms, water bodies, and natural resources—and the development of industrial activities. Industrial activities, broadly defined, include those of farm, forest, mine, factory, and transportation. Accessory to these primary industries are the essential service industries, which include communication, accountancy, and amusements. These secondary industries are not so pertinent to a discussion of industrial geography, however, and therefore will be treated only slightly.

Influences other than those geographic. While industrial geography recognizes the fundamental importance of the physical factors, one should not assume that only such factors influence industrial activity. Political factors such as wars, tariffs, and systems of government are likewise important. In the United States the necessities of war, with protective tariffs after the emergency has passed, have given rise to many industries, and in somewhat similar manner a preferential tariff system has had important industrial effects within the British Empire. The present systems of government in Germany, Italy, and the Soviet Union have given those countries different industrial complexions from those which prevailed under their former systems. Industry is always affected by the stability of government, and by the attitude of government toward industry, whether active or passive.

Another group of factors is the economic, which includes capital, labor, transportation facilities, methods of business organization, and rate policies of railroads. The supply of labor and capital tends to be more plentiful around established industrial centers.

This fact helps to account for the growth of great centers. But labor and capital are also mobile, capital being more so than labor, and may therefore be attracted to new locations. Transportation and industrial activity are interdependent: one usually cannot exist without the other. Railway competition and the variety of operating conditions which the railways meet result in a variety of freight rate policies and structures, which affect the location of industries.

The industrial ages of countries, religious influences, racial aptitudes, and various accidental and artificial factors also affect industrial activities in varying degrees.

New England as an illustration. As an introduction to the general theme of industrial geography, the New England section will be used to illustrate briefly how the various geographic and non-geographic influences may operate to control industrial activity. The region is cool and rugged and has much poor soil, which tends to limit agriculture. Nevertheless, so long as cheap transportation to other regions was lacking, the people were forced to grow their own food. Those influences which limited agriculture, however, were not unfavorable in all respects. The cool climate, which caused the people to be energetic, is the most fundamental influence in explaining the industrial progress of the region. The rugged topography, with its many glacial lakes, created not only abundant water-power resources, but has, in conjunction with the cool climate, been responsible for the recent development of a summer tourist industry.

Other favorable factors were the many good harbors, near-by fishing banks, and abundant supplies of superior timber resources. Combined, these influences encouraged the development of a fishing industry, which was to find a market in the Catholic countries around the Mediterranean and in the West Indies. Marketing of the fish required the building and manning of a merchant marine, which provided another outlet for lumber and for labor from the farms. Concurrent with the growth of the fishing industry was the rise of a market for lumber and ships in Great

Britain, which had already exhausted the domestic supplies of good timber. This situation was changed, however, with the invention of the iron steamship. The advantage in operating a merchant marine shifted to the British, who had favorably located supplies of coal and iron ore, and who had developed skilled workers in iron. At the same time, in the United States various events were turning attention toward internal improvements.

Impetus was given to manufacturing by the War of 1812 and later by the Civil War, and after each conflict protective tariffs were employed to protect the young industries. It was, however, the completion of the Erie Canal in 1816 which encouraged manufacturing most in the long run. The operation of this canal made it impossible for New England to compete with Midwestern agriculture, but there was an excellent base upon which to build manufactures. Surplus labor that had acquired some skill in home manufactures could be obtained from the farms and from the homes of those engaged in fishing and commerce. There were abundant water power and local raw materials, while returning ships brought small cargoes of many other raw materials. A moist climate and nearness to the cotton belt favored the manufacture of cotton textiles. Capital was first supplied from the small accumulations of individuals and later also from the funds of those who abandoned the shipping industry; after 1815 European capital was of prime importance.

The momentum gained in part by this early beginning has been of permanent advantage to New England. The workers acquired skill, the operators became experienced in organizing and operating factories, and capital accumulated, providing a cheap source of funds with which to expand the industries.

The rise of manufacturing and the loss of competitive advantage in growing staple crops caused a shift to dairying, for which the region is naturally fitted, and to the production of fruits, vegetables, and other specialized crops where local conditions were favorable.

Accessory industries. Since these industries will not be discussed in detail later, it may be well at this point to describe their

general significance. Modern industrial organization, with its localization of industry made possible by transportation, requires that there be specialists whose function is to organize and aid the exchange of goods among the various parts of a country and of the world. Even the transportation systems, a part of the exchange machinery, are used only at the request of those who organize the exchange of commodities. In a large country like the United States, with long distances between centers, these accessory functions become doubly necessary, and keen competition and a high standard of living permit them to be finely divided and to become complex in their organization.

Most important are the merchants or middlemen, who organize the buying and selling of goods and services. Products must be moved from places of surplus to places of deficiency. Moreover, production and consumption are often seasonal. Storage therefore becomes one of the important functions of marketing. Storage in turn calls for financing and insurance. All of these functions are performed by specialists.

Accounting is another requirement of modern industry. It is the guide by which businessmen determine the success of their businesses, and, broadly, is the check by which society determines the degree of efficiency with which its productive energies are being employed. Even under a type of organization which lacked the profit motive or which did not have a money system, accounting would be essential unless efficiency were disregarded completely.

Systems of communication, while not actually engaged in the moving of commodities, do contribute services which lessen the friction and speed up the movement of the industrial organization, and make it more sensitive. A short wheat crop in Canada or a flood in the rice district of China may be known around the world in a few minutes. Such information is of much help to managers in planning their business enterprises.

Amusements make possible the realization of a fuller life and the recuperation of the powers that are used up in the conduct of

industry. In the United States, organizing and conducting various types of recreation give rise to large industries of highly specialized type, and the amounts spent by people for recreation are, perhaps, more than would be necessary to accomplish the primary purposes mentioned above. But large-scale, specialized, machine industry, crowding and inside work in large cities, and the swift pace of American industry put a great strain on the workers; it is, therefore, a matter of common sense to provide the means whereby the productive energies can be employed as efficiently as possible.

Plan of this book. This book is divided into two parts: Part One deals with the United States; Part Two, with the remaining countries of the world. For the United States the industrial-unit basis of treatment is employed; for the remaining countries, the country basis. An extended study of the United States is justified because it is the place where most of us make our living. We wish to know, then, what we have to work with and the conditions under which we work. Our welfare, both individual and collective, will depend upon the efficiency with which we use our natural resources. To be able to use them efficiently we need to have a detailed, comprehensive knowledge of their extent and of the problems relating to their utilization.

The industrial-unit basis is made easy because climate and topography create large regions, given predominantly to one or only a few types of industrial activity, and because commerce may move unrestricted throughout the nation.

For the other countries it seems preferable to use, not the industrial-unit basis, but the country basis. The primary object is to develop an understanding of how the various countries fit into the industrial pattern of the world and to see the degree of interdependence which exists among them. Although political boundaries do not always coincide with geographic features or with economic regions, they always affect economic development. Statistics, whatever their nature, apply to countries, not to natural regions. Furthermore, international relations must be conducted

between political units. One might study the economic geography of Europe on the basis of the natural regions, but trade statistics and other data concerning the continent are given for the various nations. Certainly a broad regional study without any consideration of political geography would result in an improper understanding of that continent. For these reasons the country basis is used. This does not preclude, however, a discussion of the natural divisions within each nation, but such discussion must necessarily be brief.

Plan of Part One. In a study of the industrial geography and activities of the United States it seems logical to discuss the extractive or exploitive industries first, and among these to place the forests and the industries directly connected with them in first place. The early colonists faced a territory that was almost solidly covered with trees. They had to remove enough of these to provide land on which to grow foodstuffs, and at the same time to build houses in which to live. Lumber has always been and doubtless always will be an important construction material in this country. Next is a discussion of our mineral resources. Quarry products seem logically to come first both because of their widespread occurrence and use and because of the relative ease with which they are obtained. Next come mineral raw materials and, finally, power resources. Last among these industries is fishing, which is much less important than the other extractive industries.

The discussion proceeds next to the productive or genetic industries, which include all of the industries connected with agriculture. Fishing and forestry may also be genetic in their nature, but generally speaking they have not been so in the United States.

From these primary industries, which furnish food and raw materials for the factories, the discussion turns to the manufacturing or secondary industries, which are concerned with working the materials of the primary industries into various consumable and intermediate products.

Part One closes with a discussion of the power industries. Mechanical energy has made it possible for the nation to reach its

present state of development, and the future development probably depends more on an efficient use of the power resources than on any other factor. A treatment of the organization of the power industries will show how the nation has been able to develop its great primary and manufacturing industries.

Plan of Part Two. Proximity, racial and economic similarity, and the economic importance of Canada to the United States justify first discussing our northern neighbor. For somewhat similar reasons the discussion of Europe logically follows. Moreover, since Europe is a center of political and economic power, an early knowledge of its affairs will be an advantage. Since Africa, with the exception of Liberia, is more or less under the control of European powers, it seems advisable to discuss the various parts of this large continent in connection with the several countries which control them. Moreover, as Africa is near Europe, and as its foreign trade is not proportional to its great size, an extended treatment is not merited. Many parts are only colonies under the direct control of the mother country, by whom much of the foreign trade is monopolized.

The discussion then proceeds to Asia, to Australia, and finally back to the Western Hemisphere by way of Latin America, and from the latter the student returns to a discussion and a review of some problems concerning the United States. Thus the study is tied together for one who wishes to study industrial geography with a primary interest in the United States. The concluding chapter deals with the principles of international trade.

Part One

THE UNITED STATES

I

THE UNITED STATES FROM THE STANDPOINT OF REGIONAL INDUSTRIALISM

SINCE the United States contains a large area of land, situated in the middle latitudes, a number of types of climate and thus variety in the agricultural potentialities obtain. Large area is usually accompanied by variety in topographic features, and thus in natural resources. Within the nation, as has been stated previously, we do not have artificial restrictions to the movements of commodities; each section, therefore, is left free to specialize upon the production of the product or combination of products for which it is best fitted. As a result, the regional specialization of industry is marked. Some places, however, possess less favorable combinations of natural resources than others, and consequently the workers engaged in utilizing them are not so abundantly rewarded as are those in the more favored places. Standards of living, therefore, vary among the different divisions of the nation. It is the purpose of this chapter to outline broadly this regional distribution of natural resources and of industrial activities, and to indicate briefly the extent to which the various industrial activities have contributed to the well-being of the workers engaged in them. For this purpose the extractive and agricultural industries, manufacturing, and transportation are briefly summarized.

Before proceeding to that summary, however, it seems essential that a general outline of the physiographic features of the nation be given. The distribution of natural resources is a result of natural forces. Minerals, for example, are usually associated with rugged regions, and fertile soil is associated with plains and river valleys. A broad outline of physiographic features will thus serve to focus



Fig. 1. Land relief of the United States. *Illustration from Bu. of Agr. Econ.*

attention on their relationships to natural resources and the development of industry and transportation.

PHYSIOGRAPHIC FEATURES OF THE UNITED STATES

Natural divisions. The United States will be divided into four regions (Fig. 1): (1) the coastal plain, (2) the Appalachian highlands, (3) the interior plain, and (4) the western mountains and plateaus. Most of these regions have many natural subdivisions, but a detailed account is unnecessary.

The coastal plain. The coastal plain is, on the whole, a region of sandy soils, crossed by many rivers, extending from southern New England to the Mexican border. Along the Atlantic side the western boundary is the Fall Line, where there is water power; along the Gulf, either small areas of highland are met on the north or else the region merges with the interior plain. The interior section of the coastal plain is slightly elevated and rolling in places, and, consequently, well drained; but the coastal areas are low and marshy. The coast itself is fringed with barrier reefs and lagoons. The best harbors are along the northern part, where the plain is narrow and where the sinking of the land early caused the water to back up into many small indentations and river mouths, providing harbor space and protection as well as deep water. There are few good harbors along the remaining part. Though some of the rivers flowing into the Gulf are navigable far into the interior, those on the Atlantic are navigable for only the short distance to the Fall Line; beyond that point their valleys provide routes for railways and highways.

Natural resources of the plain consist of local areas of fertile soil, extensive pine forests, and large deposits of salt, sulphur, petroleum, and phosphate rock.

The Appalachian highlands. The Appalachian highlands extend from northern New England and New York to the center of Georgia and Alabama. They consist of a valley bounded on the east by the New England highlands and the Blue Ridge Moun-

tains (the latter in turn being bordered by the Piedmont) and on the west by the Adirondacks and the extensive Appalachian plateau, whose northern half is highly dissected. Separating this plateau from the Adirondacks, and connecting the interior of the country with the seaboard, is the low Mohawk Gap, which has been one of the major topographic features in the economic history of the nation. The valley beginning with the Lake Champlain lowland and extending to Birmingham has likewise been important in war, commerce, and settlement. Rivers, cutting deeply into the Appalachian highlands from both sides, sometimes almost meeting, provide many transportation routes across the mountains.

The mountains are high enough in some places to cause heavy rainfall, which, together with the fact that the northern half of the region has been glaciated, makes water power abundant.

The interior plain. The interior plain is a flat to gently rolling, fertile territory reaching from the Appalachian highlands to the Rockies, low in elevation in its eastern half but gradually rising until it may be a mile or more above sea level along its western edge. This plain is essentially the basin of the Mississippi River. As in the Appalachian highlands, the northern portion, because of glaciation, contains many glacial lakes and deposits. In the southern part the Ozarks and Ouachitas may be considered outposts of the Appalachian highlands. The position of that great inland water route, the Great Lakes, relative to this region and the eastern United States should be noted.

The openness of this plain on both the north and the south permits climatic influences from both directions to extend far into the interior, and its position on the leeward side of the Rockies and the long distance of some sections from important sources of moisture (for rainfall) cause large areas to be semiarid.

The Mississippi and its eastern tributaries comprise an important network of navigable waterways, but the tributaries from the west are of little commercial use. The level nature of the region is an important asset in the building of railways and highways.

The western mountains and plateaus. Westward from the Rockies is a region of highly varied topography. Extending along almost the entire length of the Pacific coast are the low Coast Ranges, while parallel to them, a short distance to the east, is the Sierra Nevada-Cascade chain. Between the two are fertile valleys and lowlands. Separating the Rockies from the Sierra Nevada-Cascade range is a vast expanse of dry territory consisting of plateaus, basins, and river valleys, interspersed with numerous small mountain ranges. The major mountain ranges are high enough to have marked effects on the distribution of rainfall and temperature and to make transportation difficult. Important natural routes are the Gila River Valley, the Royal Gorge, the plateau through Wyoming, the Columbia River Gorge, and several river valleys in the northern Rockies.

FORESTS AND LUMBERING REGIONS

Extent of forests. Forests originally covered almost all of the eastern 40 per cent of the country and the higher and more moist parts of the mountainous west. Those of the east comprised 83 per cent of the total acreage. Although three fourths of our total forest acreage is still in the east, 61 per cent of the remaining supply of saw timber is in the west—enough to last for 70 years at the present rate of cutting. Extensive forests are not found in regions having less than 30 inches of rainfall or where the mean January temperature falls below about 0° F.[1]; the best ones are where there are 50 inches or more of rainfall and where the mean January temperature does not fall much below freezing.

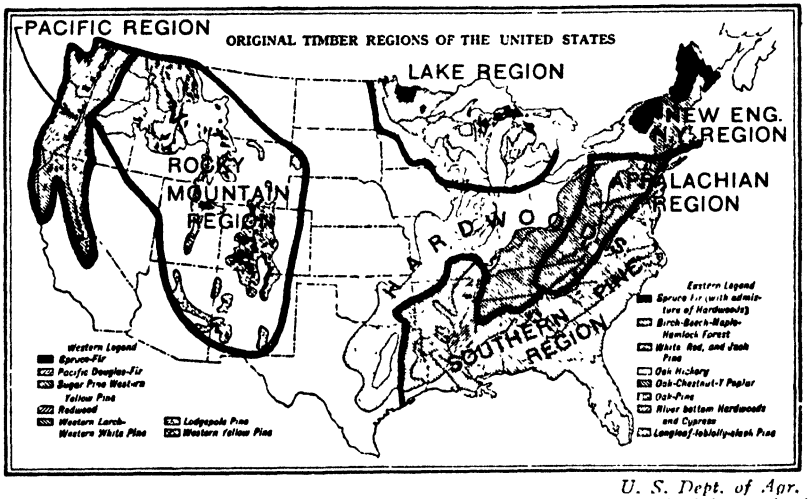
The forests of the United States may be divided into the seven regions (Fig. 2) that are used in the following discussion.

Areas of exploitation. Because of the location of the early settlements, the *New England-New York* region was the first important lumbering center of the United States. Spruce, fir, and hemlock were the leading species, with some hardwoods along the southern edge. The quality of the lumber, nearness to mar-

[1] Throughout this book temperatures are given in degrees Fahrenheit.

ket, and natural conditions which made lumbering economical were influences in the growth of the industry.

Depletion of the New England forests, cheap water transportation, and the westward movement of population caused the forests of the *Great Lakes* region to be exploited next. This section had a large acreage of white, red, and jack pine together with the same species as prevailed in New England. There was, however, a greater proportion of hardwoods.



U. S. Dept. of Agr.

Fig. 2. Lumber regions of the United States (region boundaries supplied by author).

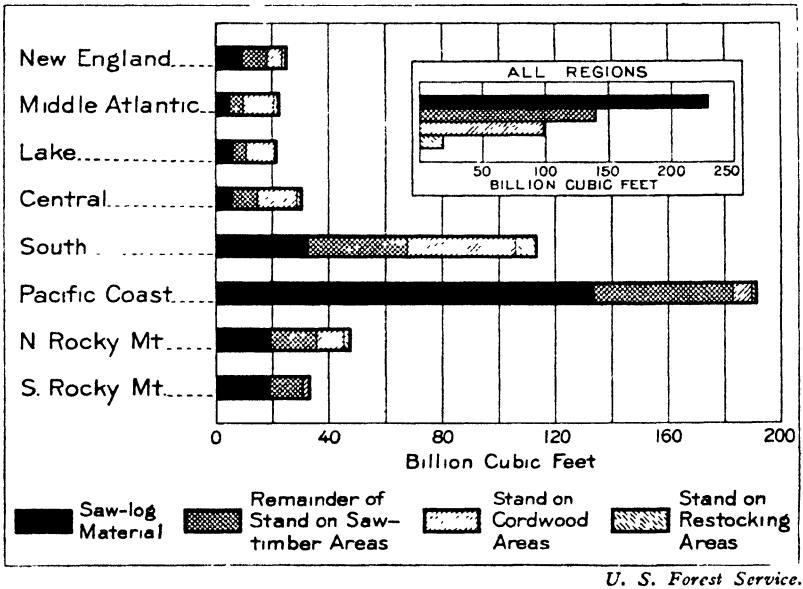
Elevation caused the species of the cool northeast to extend southward along the *Appalachian highlands,* where the quality of lumber and the nearness to market caused the supply to be exhausted rapidly. Lumbering was more expensive than in New England because of elevation, steep slopes, and lighter snowfall.

The industry next moved to the *southern pine* or yellow pine district, which extends along the coastal plain from New Jersey to central Texas. The climate is hot and moist, and the soil sandy.

The greatest area of *hardwood* forests in the world begins near the middle Atlantic coast and extends westward to the Ozarks, and grows at the lower altitudes. Large areas have been deforested because the trees occupied some of our best agricultural

lands. The leading species cut have been oak, chestnut, and hickory. It is said that the best natural conditions in the world for growing oak trees prevail at the base of the Appalachians in North Carolina, but the Ozarks are now the leading center of production.

The *Rocky Mountains* have considerable areas of softwoods, the leading species being western yellow pine, lodgepole pine, spruce, and fir, but the trees are of small diameter, occur in scattered stands, and are far from the important markets for lumber.



U. S. Forest Service.

Fig. 3. Forest resources of the United States, total stand including saw-timber areas, cordwood areas, and restocking areas, by regions.

There is, however, a local demand for lumber, and the railroads and mines provide a market for a limited production. Forest fires have done more damage here than in any other forest section.

When the yellow pine had gradually been cut and the price for lumber had risen, cutting started in the *Pacific Northwest.* Washington, with 20 per cent of the total output, is now the leading lumber-producing state, and the Pacific Northwest is our leading lumber-producing section, with an average of 41.3 per cent of the

national output for 1934-36. The Southern States, including both yellow pine and hardwood districts, followed with an average of 40.1 per cent. The forests of the Pacific Northwest, because of the mild winters, abundant rainfall, and lack of winds (which permits the trees to grow tall and straight), are the best in the world. The great size of the trees causes this area to be about 10 times as productive per acre as are the eastern forests. This productivity, the quality of the lumber, and the availability of water

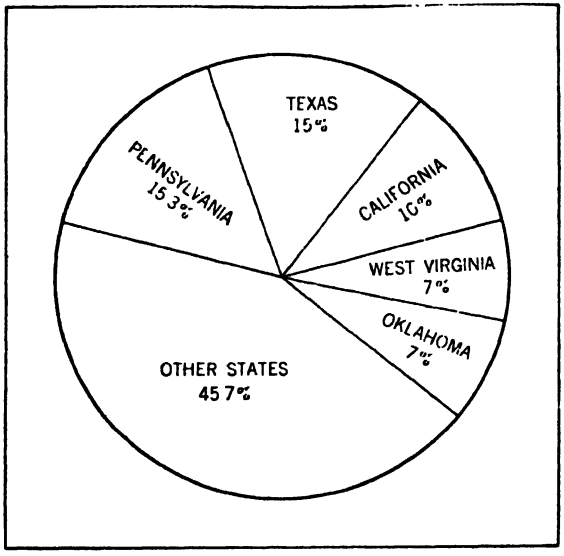


Fig. 4. Rank of states in minerals

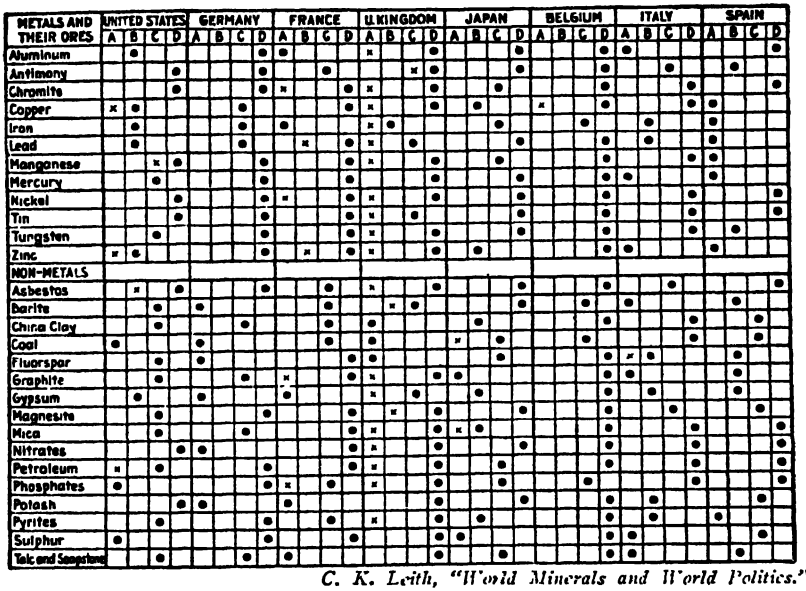
transportation through the Panama Canal give this area a competitive advantage. The leading species are Douglas fir, western yellow pine, spruce, and redwood.

MINERAL REGIONS

Five extensive mineral regions may be noted in the United States: (1) the Appalachian highlands, containing vast quantities of the baser minerals, especially of fuels; (2) the upper Great Lakes district, with large deposits of iron ore and some copper; (3) the Ozarks with their ores of aluminum, lead, and zinc; (4)

the Gulf plain, containing immense deposits of petroleum, sulphur, and salt; and (5) the western Cordilleras, containing practically all of the known minerals and possessing large supplies of the more valuable ones.

The United States is the world's leading producer, consumer, and exporter of minerals. First rank is held in the mining of about half the total number of minerals. There is, however, a lack of large supplies of such strategic ores as those of antimony,



C. K. Leith, "World Minerals and World Politics."

Fig. 5. The position of countries in minerals. The black dots indicate by their position the extent to which a country is able to supply its needs from within its own boundaries; the crosses indicate that the status of the country is improved when minerals outside its boundaries but under its control are included.

chromium, manganese, mercury, nickel, platinum, tin, and tungsten. But American capital, through investment in foreign countries, has placed the United States in a position of leadership as to ownership of foreign reserves of some of the strategic ores named.

AGRICULTURAL REGIONS

Importance of agriculture. Agriculture is the second-ranking industry of the United States, having an annual average production

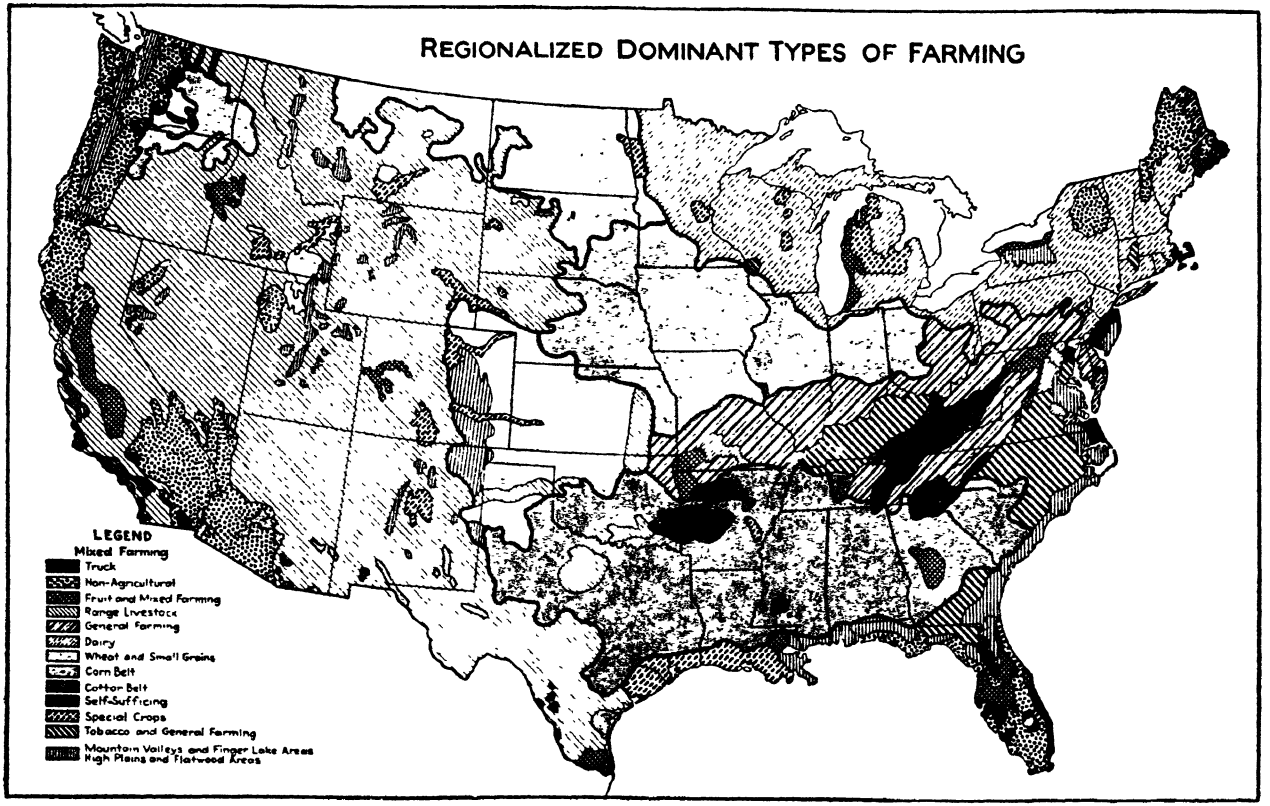
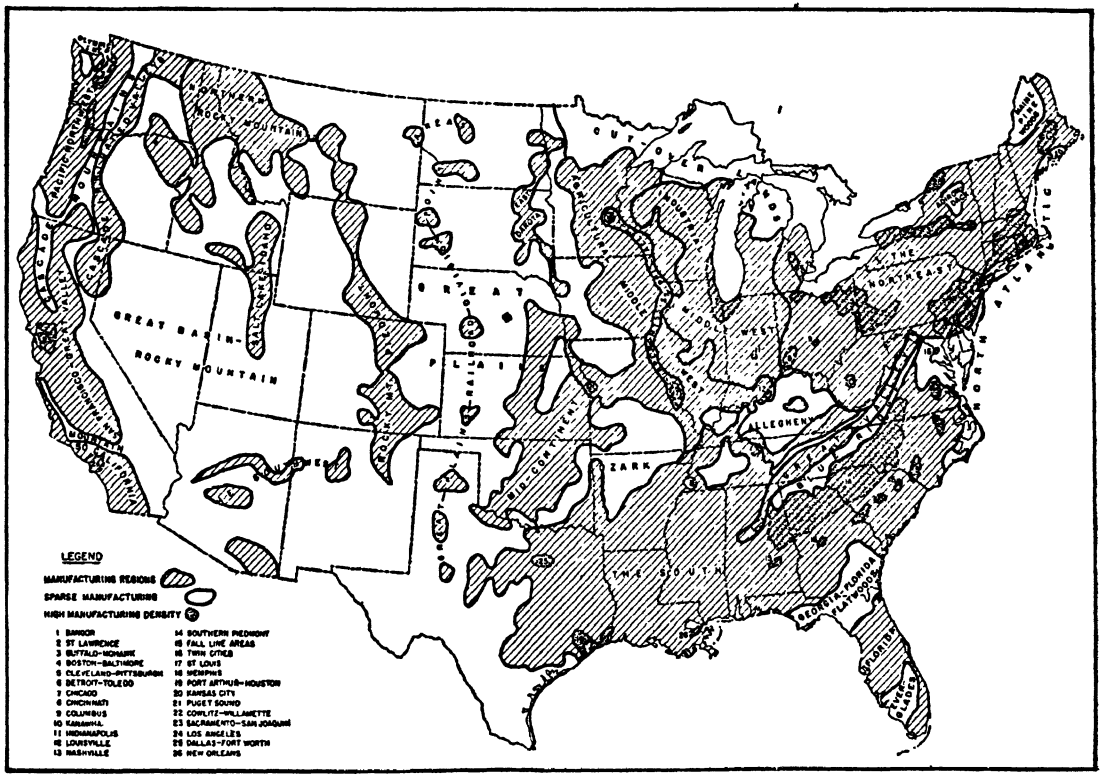


Fig. 6. Map of agricultural regions. *Planning Division of the A. A. A.*



Courtesy Miss Helen Strong and the "Annals of the Association of American Geographers."

Fig. 7. Manufacturing regions of the United States.

of about 7½ billion dollars for the period 1935-1938, which is about half of the value added by manufacture in our manufacturing industries. About 25 per cent of the people of the nation are engaged in agriculture, and about 30 per cent in manufacturing (Fig. 11). The income for agriculture was 55 per cent from animals and 45 per cent from crops. For about a decade the income from animals has been greater than that from crops. Responsible for this difference may be cheap grains, difference in relative freight rates, and more scientific progress relatively in crop than in animal production.

Geography of agriculture. The agricultural regions of the United States are shown in Figure 6. Since the production of the various animals and crops is treated in detail in chapters which follow, only those general factors which influence the use of land for the production of crops and animals are discussed here.

The production of farm products is determined fundamentally by physical factors. These have been classified by the Department of Agriculture as climatic factors (temperature and rainfall) and edaphic factors (soil and relief). The former influence the general type of farming (the cotton belt or corn belt); the latter, the use that will be made of particular areas or types of land.

But economic factors also have an important influence. A climate that is especially favorable for a certain crop does not preclude the growing of other crops in a region. The maintenance of soil fertility, the efficient utilization of labor and equipment, and the existence of local markets, together with the ability of some products to be transported and to bear freight rates for considerable distances, may cause a variety of products to be grown. Moreover, improved varieties of crops, improved methods of tillage, the introduction of new types of agricultural machinery, and improvements in transportation cause shifts in the use of agricultural land.

Where natural conditions make it possible to grow several crops on the same land, the crops which tend to get first choice of land, if there is an extensive demand, will be the ones which are most

productive per acre and have the most limited natural requirements. This is true of corn and cotton in the United States. The profitableness of crops is usually determined by their distance from markets, which is a major factor in agricultural geography.

MANUFACTURING REGIONS

Distribution of manufactures. Two types of manufacture may be recognized, namely, (1) processing and (2) complex manufac-

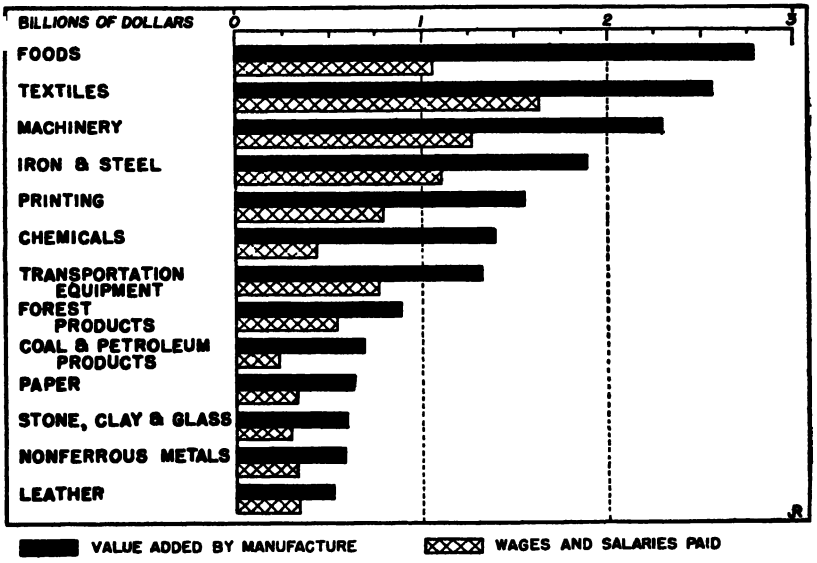


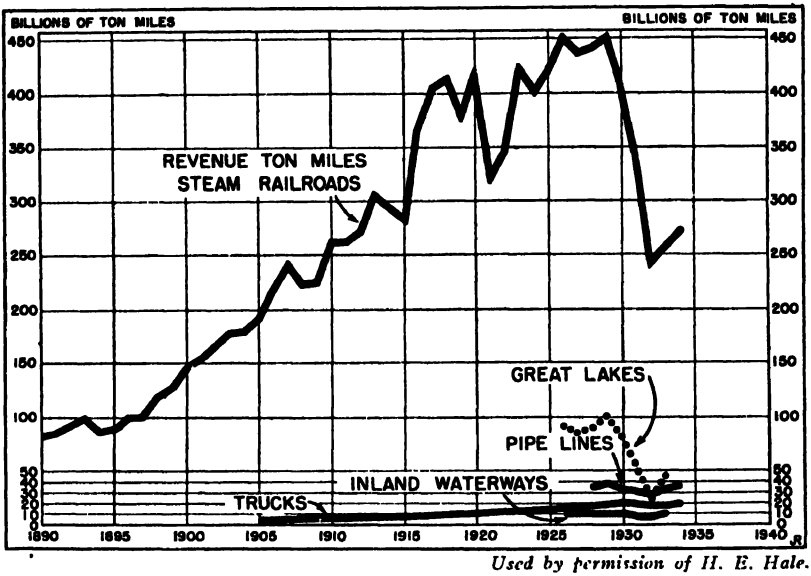
Fig. 8. Leading manufacturing industries of the United States in 1935 according to the value added by manufacture, with the wages and salaries paid by each industry.

ture. The processes of the former are relatively simple, in most cases requiring machinery and relatively little fuel. This type is concerned largely with preparing the products of agriculture for consumption and is scattered because of the widespread location of raw materials and markets and because of limits to the transportation of raw materials necessitated by low value, perishability, or proportion of waste material.

Complex manufactures, more than processing, tend to concentrate around great centers. These are chiefly the great coal fields,

or other sections where cheap hydroelectric energy is available or where cheap water transportation makes it easy to assemble the required materials (compare Figures 7, 10, and 38). Complex manufacture also involves more intricate processes, and makes a greater relative demand for skilled workmen and a more valuable type of product than does processing.

Reasons for importance of manufactures. Several influences account for the leading position of the United States in manufac-



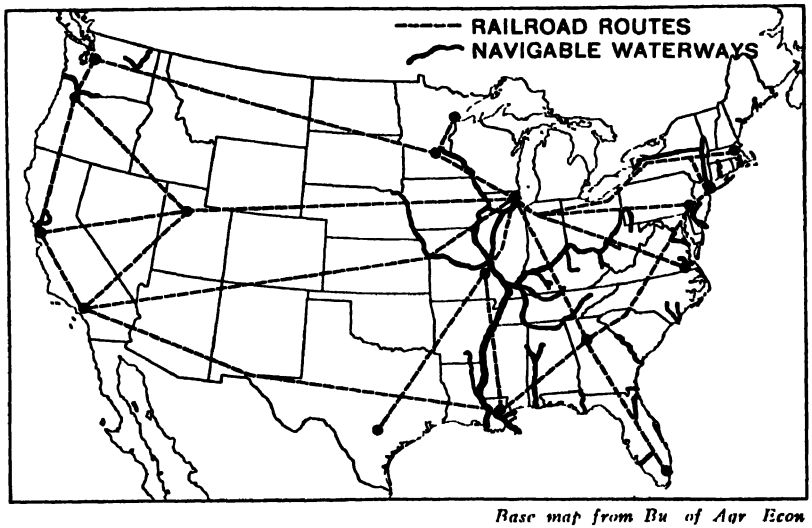
Used by permission of H. E. Hale.

Fig. 9. Ton-miles of freight hauled by the different agencies of transportation.

turing. The great size of the nation and its variety of climate, soil, and topography provide the basis for abundant supplies of food and raw materials, while the large population with a high level of purchasing power provides extensive markets for many different products. In spite of the large population, however, labor in the past has been scarce and wages high, with the result that many different types of machinery have been invented to aid in working the natural resources. Consequently, our efforts are not limited so much by the human factor as in most other countries. Heavy, expensive machinery necessitates large-scale production with its characteristic feature of decreasing unit cost.

POWER FACILITIES

Only a mention will be made here of the nation's power facilities, because they are treated fully in later chapters. Figure 130 shows the location of the important power plants and transmission lines of the country, and the manner in which the different regions are connected in order to get the most efficient utilization possible. The locations of supplies of fuel and water power and of markets for energy are evident from the map.



Base map from Bu of Agr Econ

Fig. 10. Rail routes and waterways, United States.

TRANSPORTATION

Importance. Herbert Quick[2] has called the United States an experiment in transportation. The size, shape, particular distribution of resources, and unfavorable factors relating to the use of many of the waterways, and the fact that a single political control permits the free movement of commerce among all of the natural regions—all have caused overland transportation to be an influence of major importance. The great railway mileage was a necessary expense for the development of the nation. This

[2] See *The Saturday Evening Post*, February 25, 1922.

does not mean that it adds to the cost of producing goods. Rather its general influence has been to reduce cost by making available more favorable combinations of natural resources and the other factors of production. Transportation makes the localization of industry possible. Otherwise, if we obtained products which are commonly consumed, it would be necessary to produce them locally, and their cost would usually be much higher.

Transportation routes. The general direction of transportation routes is determined by the existence of traffic to be exchanged; they connect regions of production and consumption. Some of

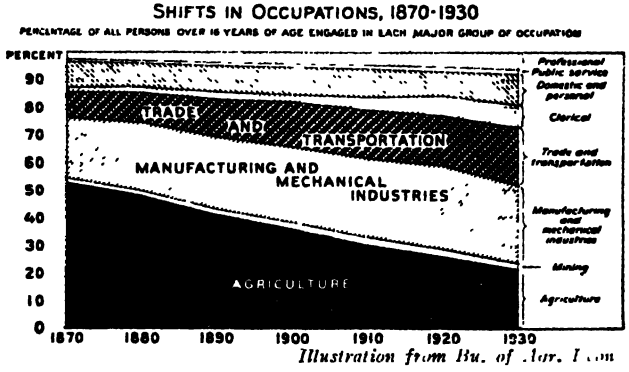


Illustration from Bu. of Lab. Com

Fig. 11. Distribution of the gainfully employed.

them extend across the oceans. Figure 10 outlines the natural overland routes of the United States. Chicago, because of its location on Lake Michigan, because of the great agricultural area in the Midwest in conjunction with the markets for agricultural products in the eastern industrial area and in Europe, and because the westward movement in the United States progressed in waves, is the leading railway center in the world.

DISTRIBUTION OF ECONOMIC ACTIVITY

Figure 11 shows the distribution of the gainfully employed, and Figure 12 the recent distribution of the national income among the major occupations. Figure 13 gives a picture of the distribution of natural resources and economic opportunities and of the

activities connected with the production and consumption of goods as this distribution is reflected in purchases made by consumers.

Figure 11 shows a gradually declining percentage of our population engaged in agriculture and an increasing percentage engaged in commerce and in the provision of services. These shifts indicate progress. In agriculture, because of continual improvements in methods, a declining percentage of farm population has been able to supply us with an ever-increasing quantity of products. This not only has reduced the cost of producing agricultural products but at the same time has released people for work elsewhere, lowering labor costs in the other occupations.

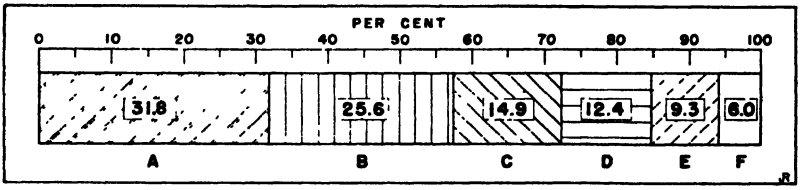


Fig. 12. Distribution of the average annual income of the United States, 1934-36, among the different industrial divisions. A—trade and transportation, B—manufacturing and mechanical industries, C—public service (includes 2.8 per cent of the national income which was spent for work relief), D—other service, E—agriculture, F—mining and unclassified (mining, 1.7 per cent).

The increase in the percentage of people engaged in commercial pursuits is partially a result of the greater use of machinery in both agriculture and manufacturing, but we also are producing a greater volume of goods to be transported and sold. The growth in the proportion engaged in providing services is an illustration of the specialization which takes place as per capita purchasing power increases, as the standard of living rises. As people obtain greater income, they are able to buy both products and services which they could not afford previously.

Note (Figs. 11 and 12) that trade and transportation, with only about 3 per cent more people employed than are employed in agriculture, return three and a half times the income that agriculture does. Manufacturing, with 25 per cent more employees than agriculture, has almost 3 times the annual income. The figures

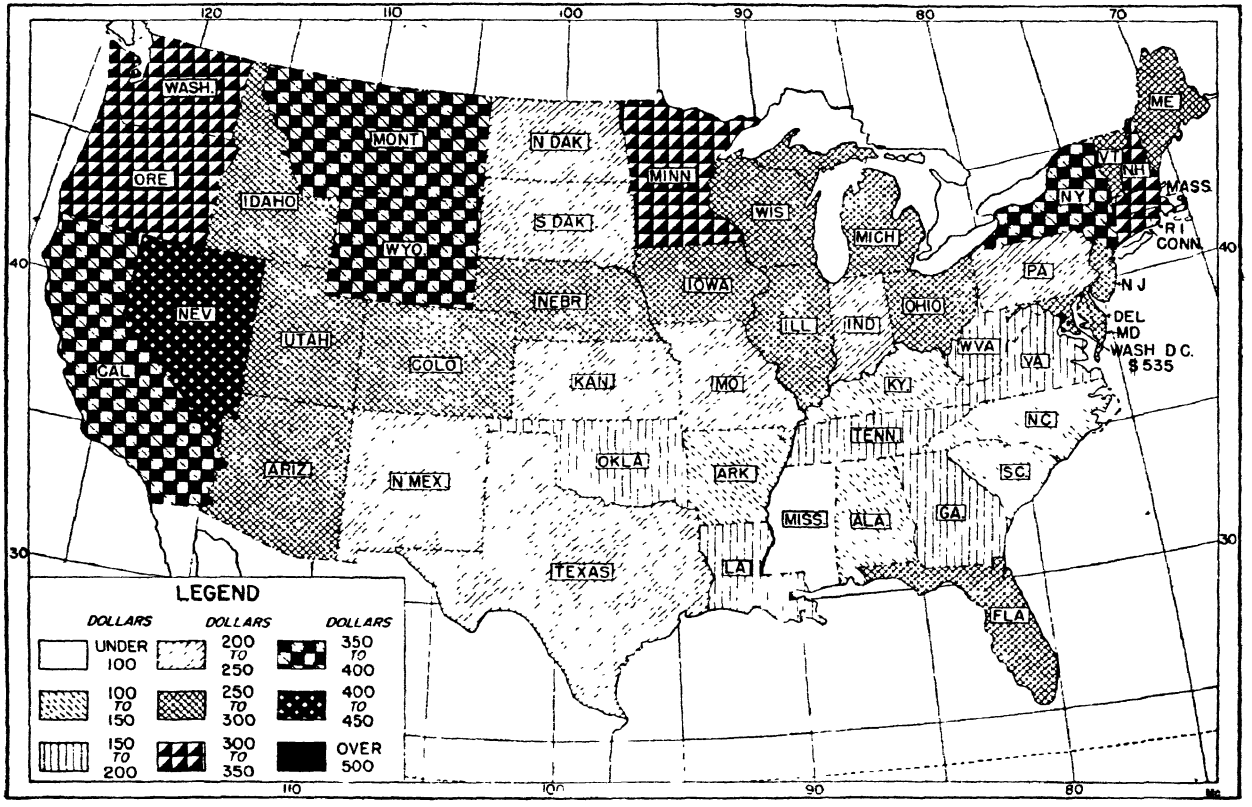


Fig. 13. Per capita retail sales of the different states in 1935. (Figures by the United States Department of Commerce.)

for public service, that is, government work, are interesting. Not including the amount which was spent for work-relief, this division, employing about 2.5 per cent of the workers, received 12.1 per cent of the total national income.

In Figures 12 and 13 the contrast between industrialism and agrarianism, particularly in the cotton belt, should be noted. While historical circumstances are partially responsible, the low level of purchasing power prevailing in most of the Southern States is largely the result of the predominance of crops requiring much hand labor. The farmers in the grain belt supplement their labor with machinery; those of the South are not able to any extent to do so. In the one case, the amount of capital which the farmer is able to command and to apply effectively is the limitation on his income; in the other it is a physical limitation—the amount of work which can be done by hand.

In the West, the states with mining, lumbering, and specialized crops stand highest in income production. Mining and lumbering are industries that require a small amount of labor relative to the output, while the specialized crops, usually grown under irrigation and of superior quality, are productive per unit of land and bring a high price on the market.

There are of course other relationships. After the reader finishes with Part One, it would repay him to turn again to Figure 13 and determine more fully the reasons for the many variations.

2

FOREST RESOURCES AND THEIR INDUSTRIAL USES

Industrial functions of forests. Forests are valuable as a source of raw materials and foods and for functions for which a monetary consideration cannot be set. The trees of the forest provide fuel, lumber, naval stores, raw materials for paper, rayon, and cellophane, and small amounts of food products, such as maple sugar and syrup, nuts, and wild fruits. Forests are also the home of wild animals from which furs and food are obtained, and, by the presence of nuts and grass, which may grow where the trees are not too thick, they furnish a basis for domestic animal industries. It has been estimated that $190,000,000 of game animals and $14,000,000 of fish are taken annually in the forests of the nation.

The most important service which forests may perform is providing the spongy mass of forest cover which retards the surface runoff after rains. The United States Forest Service recently found, in the Ohio River Valley, that forest soil is from 15 to 30 per cent more porous than field soil; and that, on a number of watersheds at the headwaters of the Mississippi, the direct runoff from grassland was more than 10 times that from forest land, and the runoff from denuded land was 35 times as much.[1]

The control of the surface runoff aids in preventing floods and soil erosion, the latter one of our most important national problems. The regulation of the flow of streams is important to irrigation, hydroelectric development, navigation, and flood control. Especially important is it to those whose property may be de-

[1] *Forest Land Resources, Requirements, Problems, and Policy,* Part VIII of the Report on Land Planning to the National Resources Board, Washington, 1934. See especially pp. 34-36.

stroyed by flood. Floods cost the nation an average of $40,000,000 annually. The Mississippi River flood of 1927 cost $300,000,000, the Ohio River flood of 1936 about an equal sum, and the one of 1937 more than $400,000,000.

The Department of Agriculture has estimated that soil erosion costs the nation $400,000,000 annually in soil depreciation and reduced yields. In a level state like Illinois, erosion is estimated to

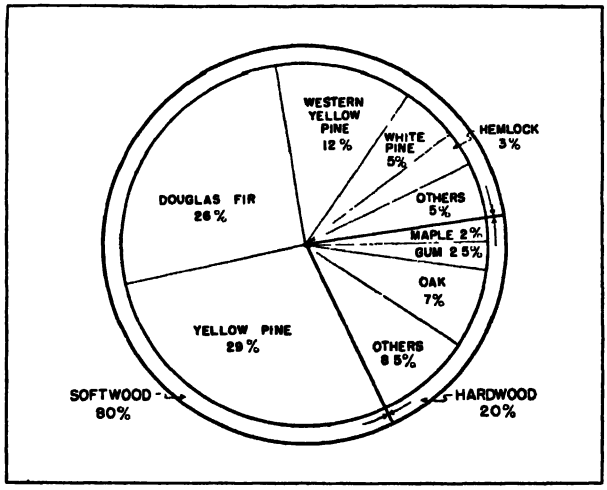


Fig. 14. Lumber contributed by various species of trees in the United States.

have removed 7 inches of soil since cultivation began. The soil that is removed from fields and mountains fills reservoirs, harbors, and navigable streams. The Federal Government spends more than $100,000,000 annually in dredging streams to maintain navigability.

Forests are also valuable for recreation, particularly since the advent of the automobile and the growth of city populations with their need for frequent outings and vacations. About 31 million people now visit our national parks annually.

Classes of wood. Woods may be classified as hardwoods and softwoods. A distinct line cannot be drawn easily between the two classes; one gradually merges into the other. In hardwoods,

the cells are closer together and more compact than in softwoods; consequently hardwoods are more difficult to work.

Coniferous, or evergreen, trees comprise the softwoods. They grow chiefly in cool regions where the precipitation is not extremely heavy. Their leaves are constructed to prevent rapid transpiration.

Uses of wood. Normally about 50 per cent of the wood in the logs cut has been made into lumber. Fuel takes about 28 per cent; railroad ties, fence posts, and pulp 4 per cent each; and cooperage 3 per cent. For several years previous to 1930, the cut had been averaging about 36 billion board feet annually. In 1937, about 22 billion board feet were cut. Our maximum cut was 40 billion board feet in 1907. Some idea of the immensity of the amount cut may be gained by remembering that about 20,000 board feet of lumber are required to construct the average frame house.

Lumber has been used extensively for building purposes, because it is a poor conductor of heat and can be obtained and used at low cost. If only the original cost is considered, lumber is still the cheapest building material. That it is still used widely is shown by a recent survey of the Department of Commerce, which found that 81 per cent of the dwellings in a group of 63 cities were of wood. Originally lumber was cheap because of the location of abundant timber resources near the market. The depletion of these resources necessitated going farther and farther from the market to obtain supplies, with the result that the average price is now about double that prevailing at the beginning of the century. Transportation costs represent more than 75 per cent of the total delivered cost of the raw material at the mill.

Lumber used by manufacturing industries. In about 60 manufacturing industries in the United States, lumber is a raw material. In some of these industries, it is the basic raw material, but in others it is only one among two or more basic materials. Planing mills are the leading consumers of lumber, using about 30 per cent of the total. Planing mill products are those which have been

made into a specific pattern, such as ceiling or flooring, and not merely pieces of lumber which have been smoothed. The crate and box industry, which uses 25 per cent of the total, is next in consumption. The manufacture of sashes, doors, blinds, and general mill construction work employs 18 per cent, furniture manufacture, 6 per cent, car construction and repair, 5 per cent, and the manufacture of motor vehicles, 4½ per cent. Other industries use much smaller amounts.

Utilization of timber resources. For some time in the United States, we have been cutting our forests about four times as rapidly as we have been replacing them. Much of this cutting is made necessary by the great waste in the cutting, milling, and manufacture of lumber. The conservation and use of our forests then involves two problems: (1) efficient utilization of the trees cut, and (2) resetting and care of young trees until they mature. The latter involves the application of scientific methods of forestry and protection against forest fires, which destroy thousands of acres of trees annually.

Sources of waste. Waste occurs in the forest, during the manufacturing process, and while the products of lumber are in use. One of the greatest sources of lumber waste lies in chopping off branches, leaving them on the ground. Besides wasting timber, this practice also increases the danger from forest fires. Many products might be made from the lumber contained in the larger branches. In Europe, even the small twigs are often saved for kindling. Much good lumber is left in stumps, in good trees which are overlooked, and in defective trees which should be removed but which are often left uncut. Many young trees are injured from having the trees which are cut fall on them. With a little care much of this waste could be eliminated.

Waste occurs at the mill in squaring logs, and in the planing mill from ⅛ to ¼ of an inch is removed from the boards. Lumber might also be saved if people would buy odd dimensions, but they prefer to buy long cuts and saw them up into the lengths desired. In milling lumber, knowledge is lacking with regard

to the best use for various species of trees and the chemical properties of many types. Consequently some species that are adapted to certain purposes are never used. Many products that now go to waste might be obtained through scientific methods. It is claimed that as much turpentine is contained in the mill waste of southern pine as is now obtained from tapping live trees. Birch, maple, and beech are cut for wood alcohol and acetate of lime, but the waste from these three species alone would make enough of those products to supply most of the domestic demand.

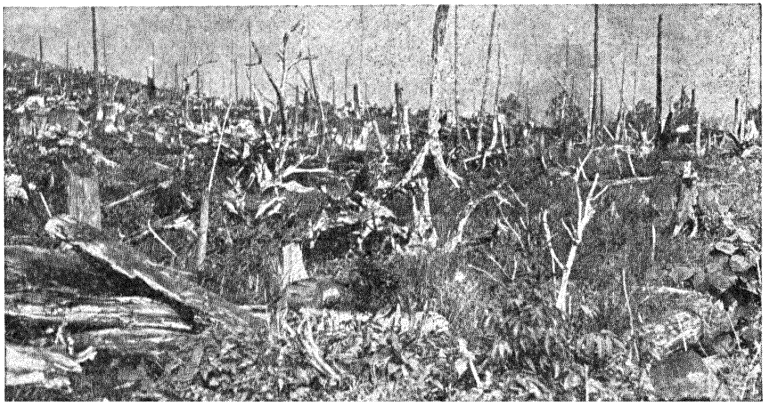


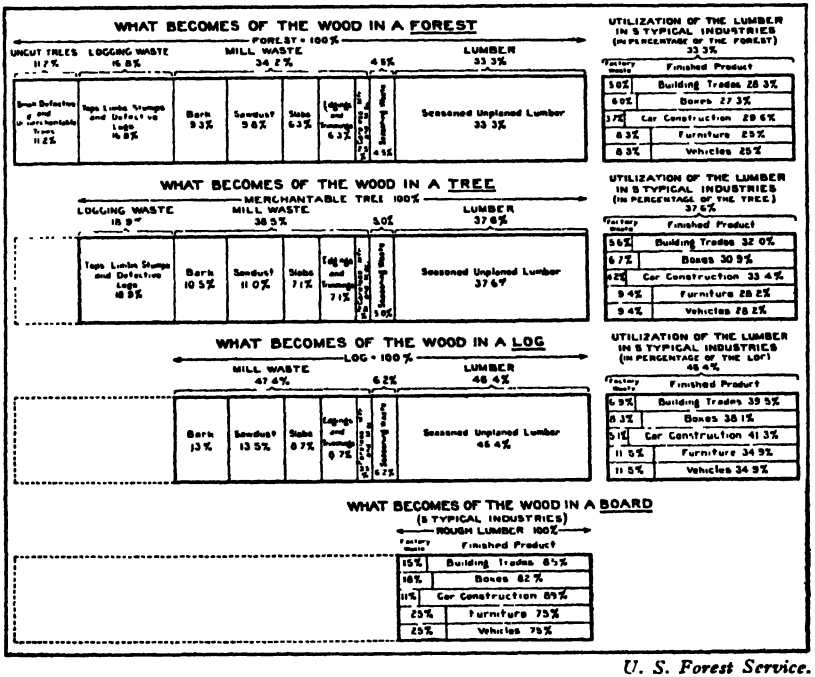
Photo by E. S. Sked, U. S. Forestry Service.

Fig. 15. Results of destructive logging and repeated fires on slopes of Mount Mitchell, Pisgah National Forest, North Carolina.

Added waste results from the lack of coördination and coöperation among wood-using industries. There should be a more complete integration of the various wood-working industries. If lumber companies and mills would diversify their products, many odds and ends of lumber could be utilized. As it is, each industry cuts trees for its special use without regard to the amount of wood that it cannot use. Some industries could use the waste of others, were they situated or organized to do it. An example is the manufacture of lumber and slack cooperage, the former having a waste of 67 per cent and the latter, which easily could use the waste of the lumber industry, a waste of 87 per cent. The branches, crooked logs, and parts that now are

burned are excellent for such purposes. These two industries also use the same species and are located in the same regions. Pulp mills, treating plants, distillation retorts, and other branches of the industry might well be conducted in connection with the sawmill.

Perhaps the most avoidable and, therefore, the most inexcusable loss occurs after the wood has been put into service. This re-



U. S. Forest Service.

Fig. 16. What becomes of wood.

sults chiefly from decay in weathering. The proper application of preservatives, whose success and value have already been demonstrated, would save millions of dollars every year. Although paint is costly, it should be applied oftener and much more generously than is now the case. Creosote will double the life of wood and make possible the substitution of low-grade lumber for the better qualities. This also saves the expense of transporting the extra lumber and the cost of replacing so frequently the worn-out

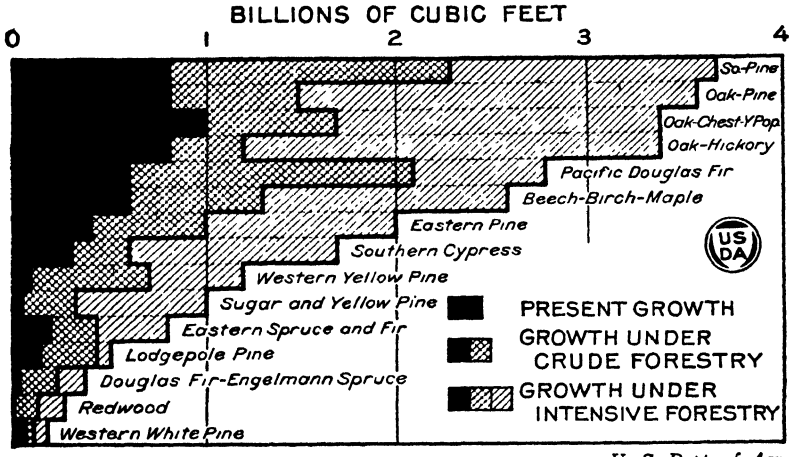
pieces. Creosote protects against both decay and marine borers. Another preservative, zinc chloride, protects only against decay. Preservative treatment also makes it possible to use dead, though sound, timber, thus permitting utilization of many trees which have been killed by forest fires.

These wasteful practices result from the abundance of timber resources. Conservation has not been necessary to assure profitable operations and relatively cheap lumber. An increasing scarcity of lumber will, through rising prices, encourage the use of less wasteful methods.

Reforestation. Reforestation work will be necessary if we are to increase or even to maintain the number and quality of trees. Another crop of trees springs up voluntarily each time the land is cut over, but each successive growth is usually poorer in quality than the preceding one. Second-growth wood can be used for many purposes, and it might well be substituted more for the better qualities, but it is not satisfactory for many of the more important uses. Unless reforestation is done scientifically, our supply of high-grade lumber will gradually decline in favor of the poorer qualities. Higher prices are an encouragement for private enterprise to enter this work. In the case of pulp companies and power companies, it is necessary that they keep their land in trees. A pulp mill is so costly that it must be built and left in one place. This requires that the land be reforested as rapidly as it is cut over. Power companies are interested in keeping their watersheds forested in order to have a more uniform flow of water for their plants. Some lumber companies have even found the scientific management of their timber supplies to be profitable.

Eighty per cent of the commercial forest land of the nation is privately owned, and thirty-five per cent of this amount is in farm woodlands. Either this will have to be owned publicly, or else the governments concerned will have to educate the farmers in the methods of scientific forestry. It has been proved that the average farmer can obtain a considerable sum of extra cash each year through the proper management of a farm woodlot.

Forestry, however, is an industry requiring capital, and the farmer is not usually willing to plant and care for a forest from which he, in his lifetime, will not gain any return. Especially is this true when the forest land is taxed in the same manner as other agricultural land, which returns an annual income. Some states, however, have special laws for taxing forest lands, and something may be accomplished through a federal law of 1924 relating to this subject. Sweden has developed a system of forestry which is



U. S. Dept. of Agr.

Fig. 17. Possible increase in annual forest growth by improved practice.

profitable under private ownership, in spite of the long-term investments.

Forests and land utilization. Our federal land utilization program, or, for that matter, any land utilization program, must consider the reforestation problem. There are about a half billion acres of land in this country on which crops other than trees will not pay, and 75 per cent of this area is of primary importance in controlling soil erosion. On some of this land, people are trying to eke out a living. It has been estimated that there are 450,000 farms, containing 75,000,000 acres, which are too poor to support families by farming. Any program of rehabilitation requires that many families be relocated, a task difficult of accomplishment

unless the government takes the initiative; and this means public ownership of submarginal lands, which should be reforested and maintained in forests wherever possible. Much submarginal land is in highland regions, and its reforestation will be of concern to farmers in the lower lands, because of a greater and more uniform supply of water for irrigation, or because such action will retard soil erosion and promote flood control.

The milling of lumber. Because of waste in milling logs and because of their low value in relation to their weight, lumber is usually milled near the forest unless water transportation is available for long distances. Rough or planed lumber is much more able than the logs to bear freight charges by rail for long distances.

Sawmills vary in size from the small, movable ones to the more efficient larger ones which are more or less permanent in their location. Some, such as one at Longview, Washington, are so large that a town may be composed largely of their employees. The small ones are usually found in sections where there are small areas of forests on the farms, and they usually remain in a neighborhood until the better logs are all cut, when they are moved to another place. The larger mills will usually be found in places where the ownership can buy up large tracts of trees and thus assure continuous operations for many years. The larger mills have their own skilled logging crews and command sufficient capital to install the most modern equipment.

Substitutes for lumber. With scarcity developing and the price of lumber rising, substitutes have increased in importance. In construction work, steel and cement are used in frames; slate, galvanized iron, copper, and patented materials in roofing; tile and cement for flooring; and marble in wainscoting and finishing. Railroads are building more cars of steel and of aluminum alloys, and are using steel and concrete in bridges and trestles. On the farms, cement is used for fence posts, well curbs, chicken and hog houses, silos, floors for buildings, feeding and watering troughs, and for other purposes. Not more than half as many wood shingles are used now as were used in 1910. In many cases the

substitute is more satisfactory than wood, and usually more durable. Metal of various sorts is also used for many of these purposes on the farm.

The use of substitutes is reflected in our per capita consumption. From an average of 495 board feet per person a year in the decade 1900-1909, it had shrunk to 315 board feet for the period 1920-1929, and about 160 board feet for the period 1935-1937. Offsetting the employment of substitutes is the fact that new industries are always arising, which depend upon our forests for their raw material.

PULP AND PAPER

Importance. Pulp, or cellulose extracted from wood, is the raw material for the manufacture of paper, rayon, cellophane, and other products. Many people think that other important uses will be discovered. Paper, however, is the most essential of all the products made of pulp. Until the middle of the nineteenth century paper in this country was made chiefly of flax and linen and cotton rags, sources still used for paper of high quality. Today 85 per cent of our paper is made from wood, and paper has become plentiful and cheap only since the application of machinery and chemistry to its manufacture from wood. Before the invention of the Fourdrinier machine at the beginning of the last century, paper had to be made by hand, and the supply was consequently limited. Now there are immense quantities of possible raw materials that are not utilized because of the cost of manufacture or the lack of knowledge of means to convert them into paper. Science probably will solve both problems.

Uses for paper in the United States. The people of the United States consume as much paper as do those of the rest of the world combined; consumption has more than doubled since 1915. A part of our heavy consumption results from the substitution of paper for other products, either because it serves the purpose better, or because it is cheaper. This is possible because of the abundant supply of wood, and because our wealth permits us to use it for purposes for which it is not used extensively elsewhere. Of a total

consumption of 14,353,000 tons in 1936, 37 per cent was for paperboard, 26 per cent for newsprint, 13 per cent for wrapping paper, and 10 per cent for books. The remainder was used for fine paper and other types.

Kinds of pulp. Wood is reduced to pulp by either mechanical or chemical means—in the former, by grinding up logs on large grindstones, and in the latter, by reduction with various chemicals.[2] Mechanical pulp is not durable, but its cheapness and lightness, factors in the cost of transportation, adapt it to newsprint purposes; durability may be increased by the addition of chemical pulp. Mechanical pulp is cheaper than chemical because of the lower cost of the processes involved, and because the output in pulp is twice as much per unit of wood consumed. Many mills make only pulp boards, which are shipped to mills making paper, rayon, and other products; other plants make both pulp and paper, the processes being continuous.

Factors locating manufacture. Like sawmills, pulp and paper mills usually locate near the supplies of raw material. Great amounts of power also are needed to turn the heavy grinding machinery, and millions of gallons of water must be used daily to wash the logs and the pulp and to prevent fire in the storage yards. Another requirement is cheap transportation, both for floating the logs to the mill and for marketing the manufactured product. New York State and New England, and the adjoining parts of Canada, all are important because of these factors.

Woods used for pulp and paper. Spruce contributes 30 per cent of the wood for pulp and paper, being favored because of its long, tough, colorless fiber and freedom from resin. One third of the supply is imported, chiefly from Canada. Southern yellow pine and hemlock each contribute about 20 per cent. In the past, dark or resinous woods, although suitable for kraft paper, could not be used successfully for newsprint paper, but new chemical processes have solved the problems encountered. A process recently per-

[2] A description of the different processes employed in the manufacture of wood pulp may be found in R. S. Kellogg, *Pulpwood and Wood Pulp in North America*, New York, McGraw-Hill Book Company, 1923, or in the *Encyclopedia Americana*.

fected may permit us to obtain all our pulp requirements from the South. This would be an advantage because of the rapidity with which some southern species of trees grow.

Other paper-making materials. Several other plants or their wastes may be used to make paper, but unless they are cheaper than wood, which is seldom the case, or will produce products of high quality, their use is limited. Much straw from the small grains goes to waste every year. A small amount is used in making wrapping papers in small factories in the grain regions. Cornstalks and cotton stalks are other possible sources. Five acres of cotton stalks will produce one ton of pulp. Hemp makes a high-grade paper that is strong and durable in thin sheets. Hemp yields well, and the retted stalks are almost half cellulose. Thus the growing of hemp solely for paper might prove profitable.

Many of these products contain unbleached material or specks which render them unfit for anything but kraft papers. It should be remembered, however, that there is a heavy demand for such papers and that profit may be made by using many products for such purposes rather than by trying to make a better-grade product on which little if any profit might be made. This practice also conserves the supplies of those products which make white and better qualities of paper.

FURNITURE

The manufacture of furniture is scattered widely throughout the East. Originally made entirely of wood, much furniture is now being entirely or in part made of steel. This applies more in the older manufacturing centers which have used up much of their hardwoods, but which continue to manufacture because of the momentum of an early start and the availability of skilled workers. These places are also located favorably with respect to supplies of steel and markets for their products.

The leading states in the order of their importance are New York, Michigan, Indiana, Ohio, North Carolina, and Pennsylvania. The last three states normally have about an equal pro-

duction. The leading city in manufacturing furniture is Grand Rapids, Michigan; High Point, North Carolina, is second. Other important cities are New York, Jamestown (N. Y.), Evansville, Chicago, and Rockford. All these cities are located favorably with respect to supplies of hardwood—a factor that seems to have been predominant in the original location of the industry.

Furniture may be classed as cheap furniture, average commercial furniture, and high-grade or special furniture, sometimes called Imperial Furniture by the trade. The greater amount made is of the second class; cheap furniture is often assembled and usually has only a local market.

Most centers producing average commercial furniture compete in its marketing throughout the nation. New York has a great local market, but is handicapped by distance from other markets. The Piedmont section of North Carolina makes more bedroom and dining-room furniture than any other district. North Carolina ranks foremost among the states in these products and holds second place in wooden kitchen furniture. High Point is an important furniture market as well as a manufacturing center. The Piedmont uses more lumber than any other section because it has not yet begun to make much steel furniture.

In the manufacture of high-grade furniture, New York City leads. This furniture is made for palatial homes, apartments, and hotels, about half being made to order largely in response to the demands of interior decorators. There are two types, the artistically made living-room furniture, and the bedroom and dining-room furniture. The cost of the wood in such furniture is often negligible, a davenport selling for $500 not having over $10 worth of wood in it. Some manufacturers buy the frames and do only the upholstering. Small shops are a characteristic feature of the manufacture of this type of furniture.

NAVAL STORES

Nature and uses. "Naval stores" is the name given to turpentine and rosin, which are distilled from an oil obtained chiefly from

the long-leaf and slash pines of the South, particularly in Florida, Louisiana, and southern Georgia. The term dates to the days when this oil or sap, either raw or cooked into pitch, was used in building and repairing wooden ships. The United States, with an annual output valued at about $40,000,000, produces two thirds of the world's naval stores, and exports about half of the production.

The paint and varnish industries consume about 80 per cent of the turpentine, and the manufacture of shoe polish about 10 per cent. Other uses are for chemicals, medicines, sealing wax, oils and greases, colorings, and in foundries and shipyards. About one third of the rosin is used in making paper and paper sizing, one fourth in paints and varnishes, and one fifth in soaps. Its minor uses are about the same as are those for turpentine.

Production. The production of naval stores has been characterized by the exploitive, wasteful methods that have been characteristic of the use of all our resources. A part of the waste was caused by the Negro labor used, and until recently the trees were tapped in an improper manner and were overworked as well. The old method of tapping a tree was to cut a deep notch or "box" at the bottom to catch the sap as it ran down from a small wound chipped in the bark of the tree above it. On large trees boxes were cut at several points around the circumference. These large cuts into the trunk of a tree injured it for lumber and also weakened the tree so that it died earlier than necessary or was easily blown down by the wind. About once a week a new chip was made in the bark, each one being above the one preceding it. Tapping was done for about seven months of the year.

The "cup and gutter" system has now replaced the box method, with an estimated saving of about $4,000,000 annually. About 20 per cent more sap is obtained, the deterioration of the timber is less, and the danger of fire is lessened. It is claimed that this method can be modified to give even better results. With this method, small cups hung along the base of the tree catch the sap, which is carried through small metal drains. The cuts into

the bark of the tree to make the sap flow are also smaller than under the other method.

After the sap is collected, it is put in a still with water, and, when this mixture is heated, the turpentine evaporates and passes to a condenser, where, being lighter than the condensed steam, it is poured off the top of the condenser. The rosin is the residue that remains after distillation is completed.

Recently a kind of turpentine called wood turpentine has been distilled from pine-wood waste. When properly refined, it is said to be as good as the ordinary kind, and it now comprises about 20 per cent of the total production.

TANNING MATERIALS

Tanning converts the inner part of hides into leather. It preserves the hide from decay and makes it waterproof without altering its other qualities. Some leathers are tanned with minerals, usually chrome or alum. Chamois skin, for example, is made by rubbing into the hide castor oil which has been treated with sulphuric acid. But by far the greater supply of tanning materials is from vegetable sources, largely the trees of the forests. It is the tannic acid in the trees and their bark that changes the hide into leather.

The chief sources of this material in the United States are oak, hemlock, and chestnut trees. Both the bark and the wood contain the acid. Originally little but the bark of oak and hemlock was used. Many trees were cut down, stripped of bark, and left to decay. Much bark is still used, but because of its growing scarcity, the extract obtained from grinding up the wood of the tree is being employed more and more. The bark of the yellow and the red oak contains from 9 to 14 per cent tannin, that of hemlock 7 or 8 per cent, and the extract from grinding chestnut wood, 28 to 32 per cent. Today oak and hemlock each furnish about 40 per cent of the bark used in the country, but chestnut provides over half of the extract. Much hemlock bark is obtained when

logs are peeled for making pulp and fiberboard. Several other species of trees are used to obtain extract. Although our tannin-producing trees are becoming scarce in the East, there are large areas of hemlock in our western forests. Large numbers of native chestnut trees have been killed by a blight, but these can be used as well as the live trees for obtaining the extract. In spite of the fact that we are the leading producer of tanning materials in the world, imports for some time have been as large as domestic production. The imports are largely in the form of extract from the quebracho forests of Argentina and Paraguay.

The various barks and extracts may be used alone or combined in different ways. The tannin from oak produces a fawn-colored leather which is considered most desirable. Hemlock makes a harsh, reddish leather. It is seldom used alone but is mixed with quebracho or oak. Hemlock and oak mixed are important in making shoe leather. Chestnut gives a brown leather and quebracho a yellowish tint. One of the favored combinations is hemlock, quebracho, and chestnut.

FOREST WILD PLANT INDUSTRIES[3]

Minor industries which depend largely upon the forests for their existence are the gathering of plants for drugs and for decorative purposes. In the United States these industries are largely in the southern Appalachians, being chiefly in the Piedmont and mountains of western North Carolina but extending also into Tennessee, Kentucky, and southwestern Virginia. Here an area about 200 miles square contains 200 of the 250 botanical drug plants found in the United States and supplies about 75 per cent of the crude drugs that this country furnishes the world. In parts of this area, the gathering of such plants is the major industry, and in some places the schools close during the winter har-

[3] For a detailed discussion of these industries see Ina C. Yoakley, "Wild Plant Industry of the Southern Appalachians," *Economic Geography*, 8:311-317, and *Forest Land Resources, Requirements, Problems, and Policy*, Part VIII of the Report on Land Planning, Washington, 1935, pp. 39-41.

vest season in order that the children may help with the work. A few attempts to cultivate these plants have been made but as a rule have not been successful.

The plants used for drugs are gathered in the summer; those used for decorative purposes are harvested during the winter. Almost all parts of the plants can be used. The decorative plants come more from the southeastern part of the area described above, where conditions are more favorable for them, Watauga, Avery, Burke, and Mitchell Counties in North Carolina leading. The leading drug plants are blue cohosh, golden groundsel, hemp dogbane, American cranberry bush, American pennyroyal, and Indian tobacco. Some drug plants are also used locally in the mountains. Boneset leaves are used for colds, balm of Gilead buds as a salve for cuts, and the bark from the root of the sassafras plant for thinning and purifying the blood. Other drug plants are jimson weeds, catnip, horehound, lady's-slipper, ginseng, and golden seal. The last three are becoming scarce. In the Pacific Northwest the bark of the Cascara buckthorn is an important medicinal product. Its harvesting is a home industry, conducted in the spring, when the bark peels easily.

The decorative plants are used for holiday purposes, especially for Christmas, which helps to explain why they are harvested in the winter, and for weddings and other occasions where decorations are desired. Galax leaves are the main product gathered, the industry centering at Marion, North Carolina. Other plants are ferns, dagger, ground pine, mountain laurel, and sheet moss.

These products are marketed through merchants, some of whom specialize in the business. They concentrate and store the leaves until the market is ready to take them. One of the leading houses dealing in drug plants is in Statesville, North Carolina. Many of the drug plants are sent to Detroit, one of the leading drug-manufacturing cities of the country.

3
QUARRY PRODUCTS

Importance. Although quarry products do not rank high in value among industrial products, they have an important place in our economic life because they provide materials for many industries and a large tonnage for the transportation agencies, and furnish much local employment. Normally more than 2,000 quarries operate in the United States; they employ more than 40,000 workers and have an output of slightly less than $200,000,000 annually.

The bulk of quarry products is sold as such. However, different kinds of manufacturing companies, for example, cement plants and some chemical plants, produce large amounts for use as a raw material in their manufacturing processes.

Types of rock. Since quarry products are largely rock or have their source in rock, one will understand them better if one has some knowledge of the different kinds of rocks.

Rock is a combination of minerals, a mineral in turn being a combination of two or more elements of the lithosphere. There are three broad classes of rock: igneous, sedimentary, and metamorphic.

Igneous rocks, among which granite and basalt are familiar examples, have their origin in the molten material from the interior of the earth which cooled as it approached the surface. They are thus associated with mountain building, and are hard, and tend to occur in great masses.

Sedimentary rocks are formed of particles eroded from preexisting rocks, carried either mechanically or in solution and deposited and consolidated into a compact form by cementation

and pressure. They are usually deposited under water and generally occur in horizontal or gently folded strata. They are ordinarily not so hard as igneous rocks and are often jointed and usually stratified, all of which makes them easier to quarry than igneous rocks. Charles K. Leith [1] estimates that to a depth of 10 miles the lithosphere contains 95 per cent igneous and 5 per cent sedimentary rock.

Metamorphic rocks may be either of the above types which have been altered by pressure, heat, or chemical reaction. Their elements are essentially the same as those of the parent rock, but the texture is different. Slate, marble, and quartzite are the most common types. They are commonly found along the flanks of mountains, either ancient or now existing, because the forces which changed them were active there. They are often harder than igneous rocks.

Rocks serve us in three ways. First, they provide materials which may be used directly for such purposes as building roads, or which may be treated chemically to obtain valuable constituents. Second, some of their constituents, through the operation of natural processes, are separated and redeposited in more concentrated forms, which are our minerals. The principal constituents of igneous rocks are feldspar, quartz, augite, and mica; of sedimentary rocks, quartz, kaolin, calcite, and dolomite. Third, rocks are the source of soil material.

Location of quarrying industries. Quarry products are widely distributed and worked, but certain areas or states stand out as producing centers. Their importance is due either to the location of the markets or to the existence in those areas of large or special deposits. Thus, Pennsylvania and Ohio are important manufacturing states and have a large demand for several of the cheaper products, such as clay, sand, and limestone. The New England States and North Carolina contain ancient mountainous areas with a complex geological structure, which results in the occurrence of different types of rocks, New England, for example, having gran-

[1] *Economic Aspects of Geology*, New York, Henry Holt & Company, 1921, p. 14.

ite, marble, slate, and traprock. To the north of the Ohio River fluvioglacial activities separated various materials into deposits of clay, sand, and gravel. California is important because isolation forces it to supply its own needs, and it has the mountains from which to obtain products. The bulk and the low value of the majority of quarry products cause them to be used near the deposits. Only those of high value or of particular adaptability to special uses are ordinarily transported for any considerable distance.

Pennsylvania normally leads the states in the production of quarry products, with about 12 per cent of the national output. Michigan produces 9 per cent, New York and Ohio, each 8 per cent, and Illinois and California, each 7 per cent.

THE STONE INDUSTRIES

Major divisions. There are two main divisions of the stone industry, the production of (1) dimension stone and (2) crushed stone. Dimension stone usually comprises a little more than 1 per cent of the combined tonnage of both, but from 20 to 25 per cent of the combined values. The average annual production and value for the three-year period 1935-1937 are given in the following table for the principal types of stone:

Stone	*Tons*	*Value*
Granite	10,241,000	$ 18,864,000
Basalt	12,423,000	11,737,000
Marble	169,000	4,878,000
Limestone	79,935,000	74,377,000
Sandstone	4,779,000	7,267,000
Other stone	8,360,000	8,065,000
Total[a]	115,907,000	$125,188,000

[a] Does not include stone used for manufacturing cement and lime. The average production of stone for these purposes was 33,161,000 tons, about 78 per cent being used for cement. The value of the stone used for these purposes is not available.

About 50 per cent of the dimension stone is used for constructing buildings, 20 per cent for rubble, and 12 per cent for monumental stones. Small quantities are used for curbing, flagging, and paving.

Limestone and granite comprise about 80 per cent of all dimension stone quarried. Recently the quantity of limestone has been

somewhat greater than that of granite, but the total value of the granite has been about 25 or 30 per cent more than that of limestone.

About 45 per cent of the crushed stone is used for concrete, 18 per cent for cement, and 10 per cent for metallurgical purposes. Small quantities are used for riprap, for manufacturing lime and alkali and for railroad ballast, agriculture, and other purposes. About 60 per cent of all crushed stone is made from limestone, 15 per cent from basalt, and 8 per cent from granite.

Quarrying. The methods employed in quarrying depend upon the nature of the particular rock and the use that is to be made of it. Thus, except for types that will not shatter, or those which are too hard to cut with machinery, stone for dimension purposes is usually not blasted; on the other hand, explosives are used for loosening stone that is to be crushed. In the case of softer rocks, channeling machines (Fig. 22) are nearly always used in quarrying for dimension stone. These machines travel along the surface of a ledge under their own power, cutting rapidly to depths of 4 to 12 feet, after which wedges are used to separate the stone. More and heavier machinery is employed in quarrying stone for crushing, and the majority of quarries are operated much like the average open-pit mine, although many quarries are operated as tunnel mines using room-and-pillar methods.

There are relatively few quarries for the preparation of dimension stone; numerous and widely scattered are those for crushed stone. The difficulty of finding the desired qualities of stone, together with the higher value of dimension stone, causes such production to be more localized. Texture, color, workability, and resistance to weathering are the important qualities of dimension stone.

Generally speaking, quarrying has been a small-scale industry with much hand labor; but in recent years mechanization has been rapid and there has been a tendency toward more concentrated ownership and larger-scale methods. The original types of machines have been improved and new ones invented. An example

of labor economy may be found in the marble industry, where one man now accomplishes as much as twelve formerly did. During the past quarter century, the output of quarry products has more than doubled, while the number of quarries normally operating has declined about 50 per cent and the number of workers in quarries, about 35 per cent. The smaller quarries cannot afford expensive machinery, nor can they ordinarily compete with the more efficiently organized, mechanized establishments.

Finishing operations. After dimension stone is quarried, it must go through various finishing processes which cut, shape, or polish it according to the use it is to serve. There are three types of operators in the stone industry: (1) those that both quarry and finish, (2) those that quarry but do not finish, and (3) those that finish but do not operate quarries. Both the types of stone and the nature of the demand influence the location of finishing operations. If there is much waste material, the tendency is to finish near the quarry, this being the case with slate and sandstone. But the major part of the limestone is sold rough to finishing mills near the large cities. These operators are in a position to know the nature of the local demand, an important matter, because limestone is more widely used for buildings than the other types.

Preparing stone for large buildings entails enormous expense. The stone must be fitted accurately to the steelwork. Data regarding the size and position of each steel shape must be had, necessitating blueprints and designs of the structure. A ticket is made for each block of stone. The cost of the paper work is often from one half to two thirds as much as the quarry expense of supplying the rough stone.

Inasmuch as techniques of operation differ among the several classes of raw materials, a brief discussion of the processes and products seems advisable.

Granite. Granite includes several allied types of rocks and is one of the few igneous rocks that is fit for use in buildings. Its desirable qualities are durability, beauty, and ability to take a pol-

ish, which make it an excellent building and monumental stone. It is adapted to more types of uses for dimension stone than any other rock, and can be quarried and finished at moderate cost.

Most of the crushed granite is produced in the southern Appalachians; nearly all of the granite for dimension purposes is quarried in New England. A large part of the output of Vermont is for monumental stone, the district around Barre producing one third of the national output of such stone. Minnesota ranks sec-

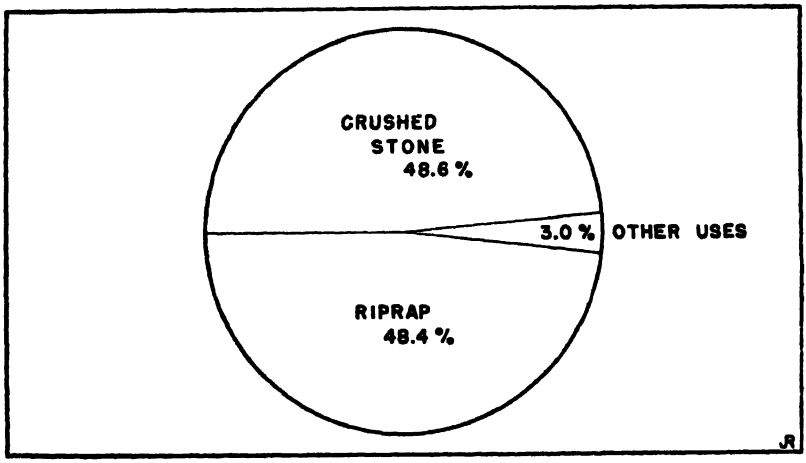


Fig. 18. Relative importance of the different uses of granite in the United States in 1936.

ond in monumental stone. Massachusetts, at Quincy and a few other points, leads in the production of building granite; Maine produces half the nation's granite paving blocks. The New England district has an advantage in producing dimension stone because of the high quality of the stone, nearness to the large eastern markets, location of the quarries with access to ocean transportation, and the skill and experience acquired through a long period in the industry.

One of the largest granite quarries in the world is at Mt. Airy, North Carolina. Stone from this quarry was used in building the Arlington Bridge across the Potomac at Washington. Other southern centers are Richmond and Stone Mountain.

California, North Carolina, and New York are the leading states in tonnage quarried, followed by Massachusetts, Georgia, Virginia, and South Carolina; but Vermont, with a much smaller ton-

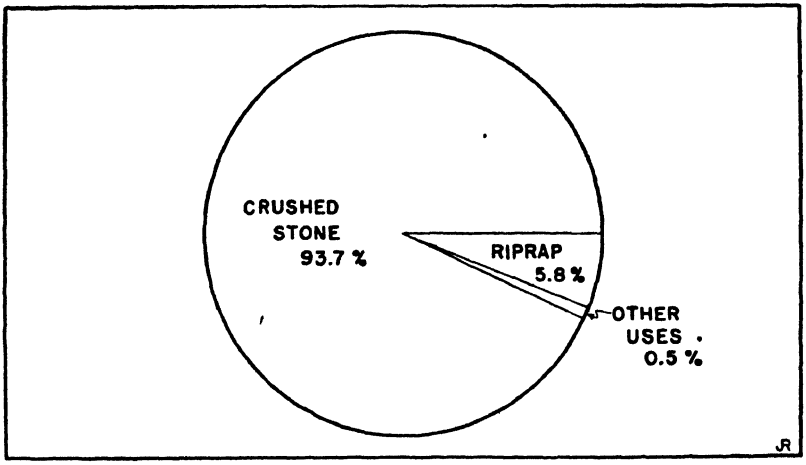


Fig. 19. Relative importance of the different uses of basalt in the United States in 1936.

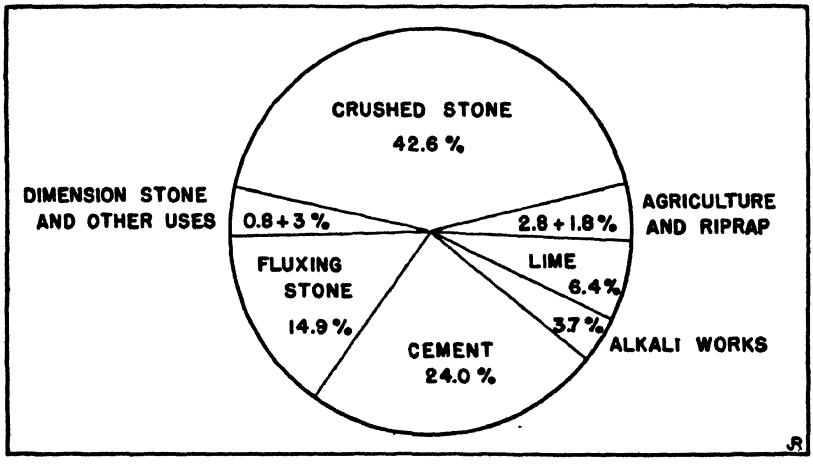
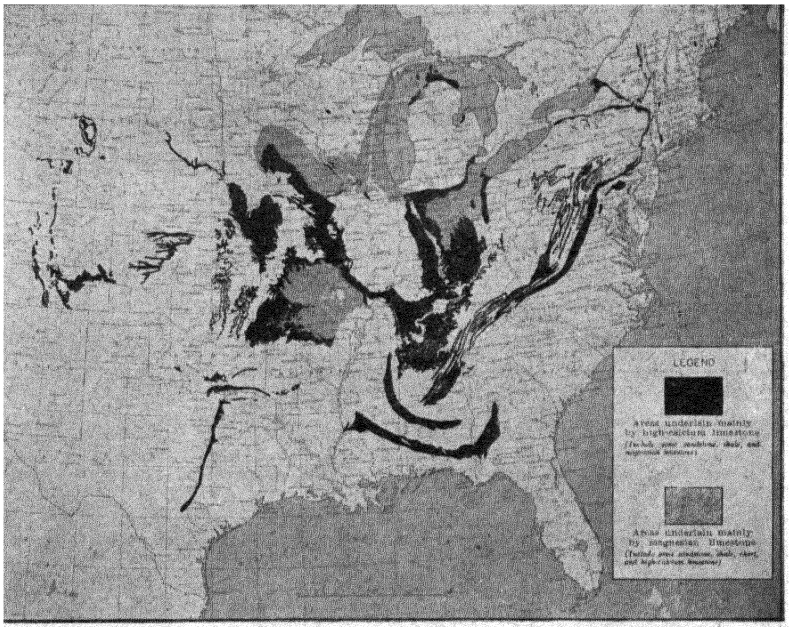


Fig. 20. Relative importance of the different uses of limestone in the United States in 1936.

nage than any of these states, ranks first in the value of its output. Of late California has quarried 20 per cent of the total tonnage, North Carolina 15 per cent, and New York 12 per cent.

Basalt. Basalt and several other types of rock of volcanic origin are known collectively as traprock. Because its dark color makes it undesirable for building stone, almost the entire production goes into crushed stone. Traprock is produced chiefly in the northern Appalachians, New Jersey and Connecticut each producing roughly 20 per cent of the total quantity, Massachusetts 15 per cent, and Pennsylvania 13 per cent. The Palisades of the Hudson in



U. S. Geological Survey.

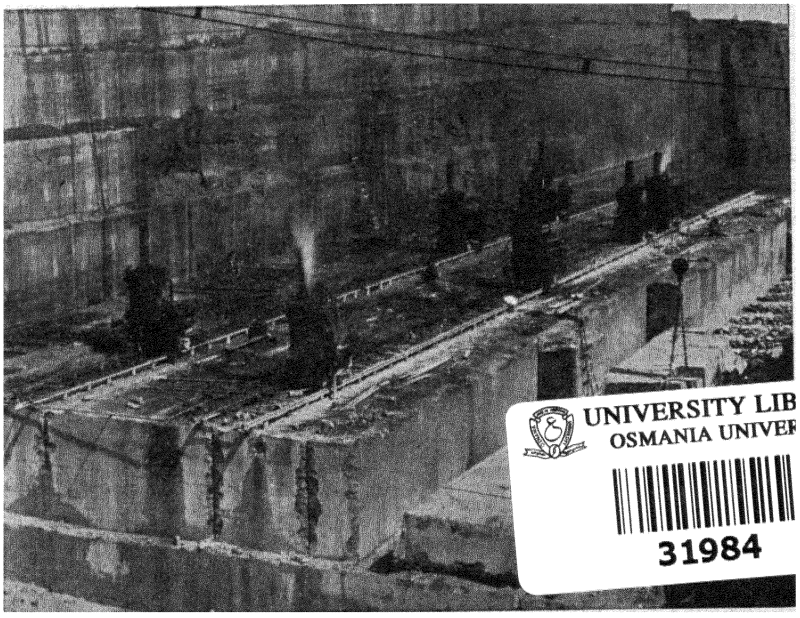
Fig. 21. Map showing principal limestone areas in the United States east of the Rocky Mountains. Areas underlain mainly by high-calcium limestone are in black; areas underlain mainly by magnesian limestone in gray.

New Jersey are formations of traprock which extend westward across the state and into adjacent states.

Limestone. Limestone has qualities which adapt it to a wider range of uses than other rocks, and which make it an essential material in more than 25 industries. It comprises more than 60 per cent of all stone quarried.

The centers of iron and steel manufacture are the leading areas of limestone production. Normally, Pennsylvania quarries about

20 per cent of the total amount. Ohio and Michigan, with cheap water transportation, each produce 12 per cent, and New York and Illinois each a little more than 8 per cent. This stone comprises over 95 per cent of the total output of stone in Ohio, Illinois, and Michigan, and over 90 per cent in Pennsylvania and New York. Indiana contributes about two thirds of the nation's supply of dimension limestone. It is taken from buff and gray oolitic deposits ranging from 25 to 100 feet in depth, near Bedford


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Indiana Limestone Corp.

Fig. 22. Channeling machines at work in Indiana limestone quarry, Bedford, Indiana.

and Bloomington. It is easy to work, and hardens with age.

Lime is an important product obtained from limestone. About half the production is used in the chemical industry, 40 per cent in mortar and plaster, and most of the remainder for fertilizer. Ohio produces 25 per cent of the lime, Pennsylvania 16 per cent, and Missouri 10 per cent.

Marble. Marble is metamorphosed limestone. Its beauty and ability to take a polish, and resistance to high temperature, are

its chief assets; but it lacks durability when exposed to the weather in moist climates. The colors are the result of impurities in the original limestone. The chief uses are normally for building, particularly interior work, and monumental stone. Marble will withstand temperatures which cause granite to crumble; consequently, in erecting fireproof buildings, the floors, and often the inside walls and ceiling, are overlaid with it.

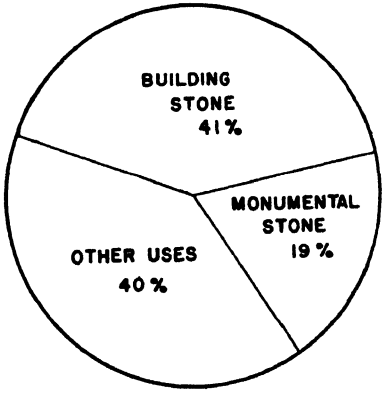


Fig. 23. Relative importance of the different uses of marble in the United States in 1936.

Vermont leads the states in the production of marble, with about 25 per cent of the total production. Alabama and Georgia are next, each with about 20 per cent of the total, followed by Tennessee, Missouri, and New York. In Vermont there are several districts; the one in the western part of the state, between Middlebury and Danby, is said to be the most productive region of its sort in the world. The quarries at Rutland are the largest in the world.

Sandstone. Sandstone generally consists of grains of quartz, a mineral highly resistant to weathering, either partially or firmly cemented together. Not all sandstone, however, is durable enough for all purposes. Some types can be crushed between the fingers. Special types are used for grindstones, pulpstones, whetstones, and other abrasives. Its use as an abrasive is declining because of the development of synthetic abrasives.

Pennsylvania usually produces about 25 per cent of the sandstone, and California a little more than 20 per cent. Other important states are Ohio, Virginia, South Dakota, and New York. Ohio produces the bulk of the sandstone used for dimension purposes. The formations extend in a broad belt from Portsmouth to Norwalk, and thence northeastward to the corner of the state.

Berea and Amherst are the leading centers of quarrying, the former contributing about half of the national output.

The older sections of the Capitol Building at Washington are of

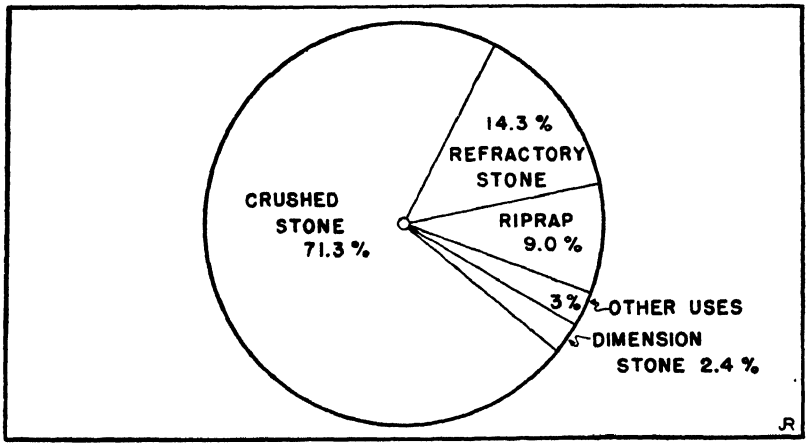


Fig. 24. Relative importance of the different uses of sandstone in the United States in 1936.

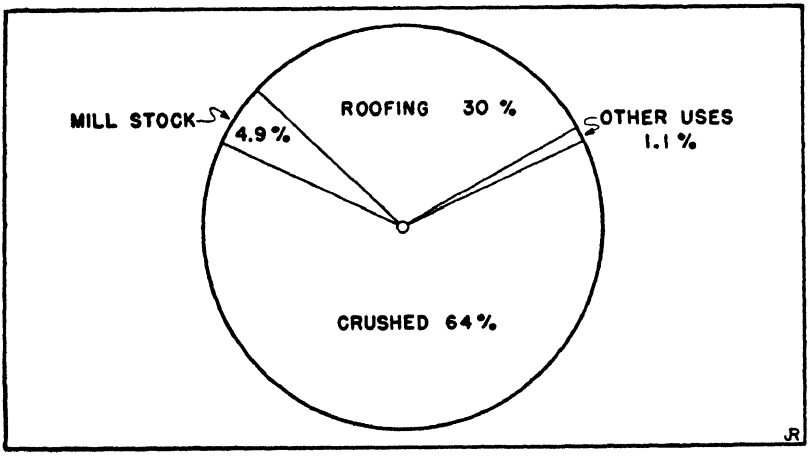


Fig. 25. Relative importance of the different uses of slate in the United States in 1936.

a soft type of sandstone which must be painted frequently to prevent disintegration by weathering.

Slate. Slate may be either metamorphosed clay or shale. Fissibility, durability, pleasing appearance, and workability are its

assets. There are three groups of slate products: roofing; mill-stock (blackboards, sanitary ware, electrical slate, interior construction); and walks and floors. Crushed slate, which results largely from a waste of 60 to 80 per cent in quarrying, may be used in cement, in composition roofing, as a filler in paints, and with asphalt as a road-surfacing material.

Normally, Vermont produces about 33 per cent of the slate of the nation, followed by Pennsylvania with slightly less than 30 per cent; however, the output of Pennsylvania is twice as valuable as that of Vermont. New York, from deposits continuous with those of Vermont, quarries about 16 per cent of the total output. This area produces the entire supply of colored roofing slate, with Rutland the leading center. A large part of the output of New York is crushed slate. The Lehigh district of Pennsylvania is the most productive slate area in the country. All classes of products and nearly all the blackboard slate are produced there.

Soapstone. Soapstone is a metamorphic rock composed largely of talc. It is marketed both as a powder and as cut stone. More than 90 per cent of the output is crushed. Soapstone is easy to work and has a high resistance to the effects of acid and heat. The cut stone, therefore, is used for the tops of such products as laboratory tables, laundry tubs, sinks, furnace blocks and linings, footwarmers, and fireless cookers. Most of the supply of cut stone is quarried near Schuyler, Virginia.

Ground soapstone is used as a filler in paper, rubber goods, and paint, and in electrical insulation, face powder, and ceramics ware, giving the latter the ability to resist sudden heat shocks. New York, in the region east of Lake Ontario, produces about half of the national output of soapstone. Vermont produces less than half as much as New York.

SAND AND GRAVEL

Sand and gravel are produced by private companies for sale, and by public agencies for use in various types of construction. Recently about one third of the production has been by public

agencies. Gravel comprises about 55 per cent of the combined tonnages of the two, and its use has been increasing relatively. Sand averages about 11 per cent more in value per ton than does gravel, but for those uses for which either will serve, gravel is somewhat more valuable than sand. The cheapest grade of each is used for railroad ballast. The best grade of gravel is used for building and is about twice as valuable as that used for ballast. The best grade of sand, used in making glass, is about six times as valuable as the poorest type and almost three times as valuable as the best gravel.

The chief uses of each are in building and paving, about 50 per cent of the sand and 40 per cent of the gravel going to the former, and 33 and 45 per cent, respectively, to the latter. The remaining production of gravel is used largely for railroad ballast, while the next-ranking uses for sand are for molding in foundries, for making glass, and for engine sand.

Both sand and gravel are produced near the market or where water transportation is available, and are the leading products carried by the inland waterways. The important centers of production are near the manufacturing centers of the East. New York stands foremost among the states, with 10 per cent of the total output; California, Michigan, Ohio, and Illinois are each almost as important as New York.

FELDSPAR

Feldspar is the name given to a group of minerals of similar properties and of widespread occurrence. In most deposits the crystals are not large enough or concentrated enough to be of commercial importance. The chief uses are the manufacture of glass and ceramics ware, where low melting point is an advantage. At present about 50 per cent of the production goes into glass and 43 per cent into ceramics ware. It is also used in abrasives, scouring soaps, stucco work, and for facing cement blocks to give them the appearance of granite.

North Carolina produces about 45 per cent of the supply, and

Colorado and South Carolina each about half as much. There has been a recent shift to the lower-cost mines of the West. Previously there had been a shift from New England to the South.

CLAY

The term "clay" includes materials of varying physical, chemical, and mineralogical qualities. The main asset of clay is plasticity, which permits molding into forms that harden after exposure to high temperatures. Varying qualities adapt different deposits to different uses. Kaolin (china clay) is the most expensive type, being two or three times as costly as fire clay, the type used in making bricks and other heavy clay products. The cheapest clay is that used for stoneware, which sells for about one fourth the price of kaolin. Most of it is produced in Pennsylvania and Ohio.

Kaolin is rare, being found chiefly in the South Atlantic States and the states of the middle Mississippi Valley and along the Pacific coast. It is white and not very plastic; other clays are often added to give it plasticity. In addition to its use in china ware, kaolin is made into white brick and white tile, and is used for weighting paper. Nearly the entire output of South Carolina is used for the latter purpose.

We have always imported kaolin, but recently it has been found that by mixing different qualities and by employing more careful methods of mining and purification, the domestic china clays can be made almost the equal of the foreign. Our present imports are only 40 per cent of the 1925-1929 average. We still import, however, because the English clays have a lower melting point than some of the domestic. Since clays may also be transported as ballast in ships, transportation charges are low.

Ordinary clays are found in nearly every state and can be used for the cheaper clay products unless they contain too many impurities. These clays are a mixture chiefly of clay and sand, some of the best clay for bricks containing as much as 30 per cent of sand. The function of the sand is to keep the clay from shrinking

when heated. The color of the finished product depends upon the other constituents (iron, magnesia, potash, or soda) and upon the conditions of burning. About 90 per cent of the clay which is used in making bricks and other heavy clay products is mined by the companies which manufacture these products. Production is scattered widely because neither the raw material nor the finished product is valuable enough to bear high freight charges. Ohio, Pennsylvania, Illinois, New Jersey, California, Indiana, New York, and Iowa are important producers of this type of clay.

In some parts of the country a clay called "gumbo" is burned in small lumps and is used as ballast by many railroads.

Pennsylvania and Michigan each contribute about 11 per cent of all clays that are produced for sale Missouri and Georgia about 8 per cent each, and California 7 per cent.

FULLER'S EARTH

Fuller's earth is a claylike substance with a high absorptive capacity for grease and for the basic colors in oils. It was first used by fullers to scour grease from cloth and by furriers to remove grease from furs. At present 90 per cent of the production is used to remove the color from petroleum in refining. Nearly all of the remainder is used for a similar purpose on vegetable and animal oils. Georgia and Florida produce about two thirds of the supply. Texas ranks third.

GYPSUM

Gypsum usually occurs in deposits which have resulted from the evaporation of sea water. As alabaster it is carved into many different objects, and for this purpose its use dates to antiquity. It is sold in two forms, raw and calcined, the latter accounting for about 70 per cent of the total quantity quarried. About two thirds of the raw gypsum is used for a retarder in Portland cement. and most of the remainder to correct acidity in agricultural land Two thirds of the calcined product is used in making plaster. A

new heat-insulating material consists of a three-quarter-inch board of gypsum covered with a thin sheet of aluminum. Small amounts of calcined gypsum are used in making plate glass, pottery, terra cotta, and several other products.

The United States has sufficient reserve to supply the world for centuries. Wyoming alone has enormous reserves. New York produces about 25 per cent of the output. Michigan contributes about two thirds as much and is followed by Iowa and Texas.

4

THE IRON ORES AND THE FERRO-ALLOY MINERALS

Groups. Under this title are included the minerals which are employed in making the various types of iron and steel products. There are two groups: (1) iron ores, and (2) the ferro-alloy minerals—containing elements which, when added to iron, impart some desirable quality to it. Of the second group, chromium, nickel, manganese, tungsten, vanadium, molybdenum, silica, and magnesite are the ones commonly used.

IRON ORES

Importance. Except for those of aluminum, the ores of iron are more abundant than those of any other metal. The rocks of the lithosphere contain an average of about 4½ per cent of iron and 7 per cent of aluminum, but only the deposits which have a high metallic content are commercially profitable under the prevailing methods of extraction. Iron ores of less than 25 per cent metallic content cannot at present be worked profitably.

The major use for iron is for making steel, which is formed by adding alloys to iron, the ordinary steels being a combination of iron, carbon, and manganese. Small amounts are employed in making wrought iron, cast iron, and other products.

Iron owes its great use to its many desirable qualities and to its cheapness. It can be hardened, softened, and then rehardened better than any other metal. Its cheapness results from abundance and ease of obtainment.

Geological formation. Iron-ore deposits are found where the particles have become concentrated. There are two types of de-

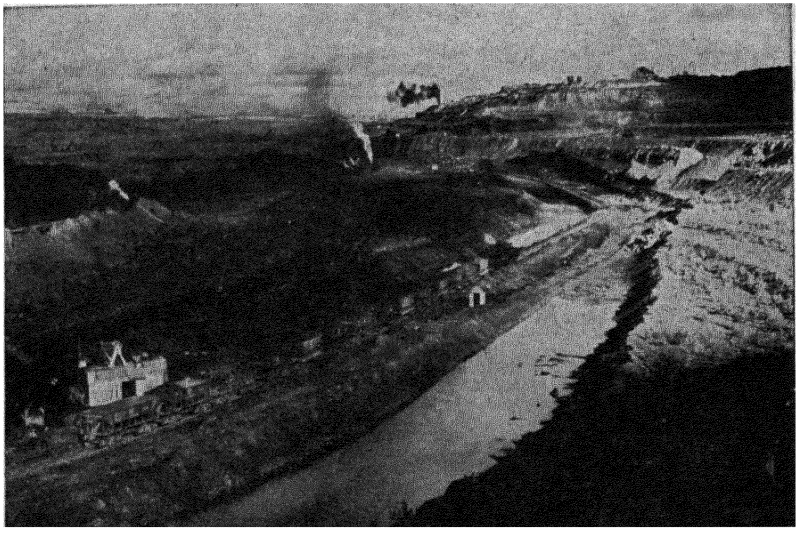
posits: igneous and sedimentary. Igneous deposits become concentrated within or near a mass of molten rock. The iron ores of New York, New Jersey, and eastern Pennsylvania are of this type. Sedimentary deposits are of two types, the one remaining as it was deposited, the other having some of the impurities removed by the action of underground water, and being called a secondary deposit. The ores of the Birmingham district are of the first class; those of the Lake Superior district belong to the second. Most of the Lake ores thus far mined have had an iron content of from 50 to 70 per cent. Practically the entire production of the United States and over 90 per cent of that of the world is from sedimentary deposits.

Types of iron ore. Most of the iron ores of commercial importance are iron oxides, which occur in the form of hematite, limonite or magnetite. At present about 95 per cent of all the iron ore mined is hematite. Limonite is chemically similar to hematite but contains water, which is removed by roasting before the ore is shipped. Magnetite contains a higher percentage of iron than the others but is not so abundant.

Centers of production. The United States normally produces over one third of the iron ore of the world, about 85 per cent of which is from the Lake Superior region. Minnesota contributes over two thirds of the amount from this region, and Michigan, most of the remainder. The Mesabi Range in Minnesota is the leading single producing range in the world. Normally about 80 per cent of the output of this area is mined by open-pit methods, employing the most modern of heavy machinery. The productivity per man in these open-pit mines is two and a half times the average in the underground mines in this country. In 1936 in Michigan the cost per ton of ore mined was $3.99 by underground methods, compared with $2.22 for open-pit methods. Incidentally, as these deposits are depleted and poorer reserves have to be worked by underground methods, the cost of iron and steel products may increase considerably.

Jefferson County, Alabama, is the only other important area of

production in this country. There, almost within the city limits of Birmingham, it is said that enough iron ore exists to supply the world for the next century. From this county comes 85 per cent of the ore mined in the Southeastern States. This ore is of lower quality than that of the Lake Superior district, 2.36 tons of ore being required to obtain one ton of pig iron, compared with 1.67 tons for Pennsylvania, which uses chiefly Lake ore. For many



United States Steel Corp.

Fig. 26. View of Hull-Rust Mine near Hibbing, Minnesota.

years the average iron content of the ores used in the United States has been about 50 per cent.[1]

In 1936, 48,789,000 tons of iron ore were mined, which was 25 per cent below the 1925-1929 average; in 1937, 72,166,000 tons were mined. The Lake Superior district produced 85 per cent of these quantities, and Alabama 9 per cent. The remainder came from scattered locations, the leading ones being the Adirondacks, the Cornwall and the Pittsburgh districts of Pennsylvania, southeastern Wyoming at Sunrise and Emma, and the Iron Springs district of Utah.

[1] See *Minerals Yearbook*, 1936, p. 377.

Iron-ore reserves. Estimates of the iron-ore reserves of the United States vary from 5 per cent to over 30 per cent of the world total. The more reliable indicate that they are a little less than 20 per cent. Exploration of the frontiers of the world may alter this figure. Recent discoveries have shown the reserves of some countries to be much greater than they were thought to be a decade ago. But it is not sufficient to know merely the quantity of the reserves. Quality, the rate of consumption, and location with respect to cheap transportation are also important.

The reserves of the United States are estimated at 5 billion tons. The Lake Superior district contains 50 per cent of this amount and the Southeastern States 40 per cent. The remainder is largely in the northeastern part of the country. At normal rates of consumption, it is estimated that the high-grade Lake ores will be exhausted in about a half a century.

THE FERRO-ALLOY MINERALS

Importance. The ferro-alloy minerals are important for two reasons. First, they give qualities to steel, such as hardness or toughness, which permit it to be used in ways not otherwise possible. Second, by making steel more durable, these minerals help to conserve the reserve of iron ore. The average life of steel in the United States has doubled during the past half century, and alloys have been a contributing factor of major importance.

There are two groups of alloy steels—the alloy tool steels, or those used in machine shops for fashioning various metal products, and alloy steels for making parts for machinery. The first type must be hard and have the ability to hold its temper at high temperatures. The second type has various desirable features, among which are high tensile strength and resistance to repeated shock, which permit the design of lighter and smaller parts than would be possible if ordinary steel were used. In making the steel, any one or a combination of the various ferro-alloys may be used. Used in either manner, varying proportions will impart different qualities to the steel.

The manufacture of alloy steels is a new, but growing, industry, and seems to have immense possibilities. High costs now limit the market. The shipment of ferro-alloys in 1937 was 971,000 tons, valued at more than $86,140,000. Production for the 5 years 1925-1929 averaged 715,000 tons. Ferro-manganese contributes about 33 per cent of the total value of alloy steels and ferro-silicon 25 per cent. Alloy steel comprises about 6 per cent of our total output of steel in tonnage. The automobile industry uses more than 60 per cent of the output. These metals all have uses other than as alloys, but only the latter is pertinent to the discussion of this chapter.

Manganese. As was stated above, manganese is added to every ton of ordinary steel. Thus used, it is not to be included with the other metals discussed in the remainder of this chapter. It is, however, employed as an alloy, and in combination adds to steel toughness and resistance to abrasion, fitting it for mining machinery.

Fourteen pounds of metallic manganese in the form of an alloy with iron and carbon is added to every ton of average steel. The carbon in the alloy raises the carbon content of the steel to the proper proportion.

Two alloys, ferro-manganese and spiegeleisen, are used to form manganese. The former, made from an ore of high purity, is from 70 to 80 per cent manganese. Spiegeleisen, made from low-grade ores, is from 16 to 32 per cent manganese. Spiegeleisen is much the cheaper of the two alloys and may be substituted for ferro-manganese. Practically the entire output of manganese is used in the manufacture of steel.

Because of the careful control which must be maintained during the process, most steel companies find it better to purchase their alloys than to make them themselves. Some firms specialize in manufacturing manganese alloys, which they sell to steel manufacturers.

The United States has several widely scattered small deposits of manganese ore of varying purity, the largest of which are in Min-

nesota and Montana. Generally speaking it has been more economical to import manganese than to mine our own deposits.

Nickel. Other than manganese, nickel is the most widely used alloy metal in steel manufacture, and this is the main use for nickel. No suitable substitute has been found, although copper and cobalt will give similar results, and chromium is used extensively in plating. Since ordinary steel is not tough and elastic enough for armor plate, machine steel, or propellor shafts, chromium is added along with the nickel. From 2 to 4 per cent of each is used. Monel metal, a natural alloy of nickel and copper combined with iron, is used for valves in high-pressure steam systems, in propellors for vessels, and in several articles that must resist the action of corrosives. Cooperite, another nickel alloy, is a mixture of nickel and zirconium, and may be used instead of tungsten in high-speed tools. The United States produces a negligible amount of nickel as a by-product of copper production in the West, and of lead and zinc production at Fredericktown, Missouri. Imports are from the Sudbury district of Canada, which produces 95 per cent of the world supply.

Chromium. Chromium, obtained from chromite, is used chiefly in making chrome steel, a product noted for its hardness and strength. It is used much in making armor plate and projectile bearings, and the wearing parts of ore-crushing mills. It is used also in plating, for it resists staining better than some other materials. Stainless steel is about 12 per cent chromium; axes, hammers, and chains contain about one per cent.

Nichrome, a chromium-nickel alloy with a high melting point, is used in electrical heating devices.

Deposits of chromite are found widely scattered in the eastern and western parts of the United States, but domestic production is negligible. California and Oregon have the best deposits. Imports are chiefly from Southern Rhodesia and from Cuba.

Vanadium. Vanadium is used both to drive other elements out of steel and as an alloy. Small quantities will make steel tough. It is used to make steel for high-speed tools. Tough steel

is necessary for axles for automobiles and the tires and frames of locomotives.

Deposits of vanadium are found in southwestern Colorado, southeastern Utah, and in other scattered places in the Southwest. Most of the supply is imported, Peru being the principal source.

Tungsten. Nearly all tungsten used is in the manufacture of high-speed tools, which sometimes contain as much as 20 per cent tungsten. Small quantities are used in making valves and valve stems for internal combustion motors, and in magnetic steel. The average steel for saw blades contains 2 or 3 per cent. Tungsten steels will do five times as much work as carbon steels, because they hold their temper at a much higher heat. The great increase in the efficiency of machine shops and rapid advances in cutting tools is due largely to tungsten. Tungsten steel will remain hard when red hot.

Stellite is an alloy containing both tungsten and chromium. It was used to cut shells during the World War, and was better than steel containing only tungsten.

The chief centers for the production of tungsten are in Boulder County, Colorado, at Atolia, California, and at scattered places in the Great Basin. The Black Hills are also thought to contain valuable reserves.

Molybdenum. Molybdenum is one of the newest of the alloy metals, but it has been making rapid strides, even supplanting tungsten in several products. For years the standard formula for high-speed tools was 18 per cent tungsten, 4 per cent chromium, and 1 per cent vanadium. At present, manufacturers are standardizing on a formula of 8 per cent molybdenum, 2 per cent tungsten, and the same amounts of chromium and vanadium that were used in the original formula.[2] Molybdenum does best in a combination with other alloy metals, and as little as 5 pounds in a ton of steel will impart the desired qualities.

Molybdenum is valuable where stresses and vibrations occur, as in automotive equipment and steamships, and where very high

[2] See article on molybdenum in *Fortune*, October, 1936.

temperatures must be withstood. Like tungsten it will stay hard when red hot. It is also desirable for war steels. Both molybdenum and vanadium are added to steel for making centrifugally cast guns. The former also increases the magnetic quality of steel.

The United States, in a deposit at Climax, Colorado, possesses 95 per cent of the known commercial reserves of the world.

Cobalt. Cobalt is used as an alloy in nonrusting, high-speed cutting tools and in permanent magnets. Its magnetic qualities make it an excellent alloy for the drivers of electric motors. Our supply of cobalt must be imported, Canada and Northern Rhodesia in Africa being the chief sources of supply.

Titanium. Titanium, plentiful in nature, increases the hardness, strength, and wearing qualities of steel, and improves the resistance of stainless steel to corrosion at high temperatures. It may be substituted for vanadium in cast steels. Konel, the name of a metal containing cobalt, nickel, and titanium, remains stronger and tougher at high temperatures than any of the others. Titanium is used also in making smoke screens and in sky writing. There are large unused deposits in Virginia and at Pablo Beach, Florida. India is the leading source of supply and Norway the secondary source.

Uranium. Uranium is scarce and has few uses. As an alloy it is used to harden and toughen steel. Its leading use is as a source of radium.

There are reserves of ore in the Rocky Mountains. Most of the production is from Colorado and Utah.

Zirconium. Zirconium is resistant to the action of heat and chemicals and, therefore, has a limited use as a refractory material and in the chemical industry. As an alloy it is used in the manufacture of ordnance and armor plate. Its leading uses are in enamels, electrodes, and in coating for welding rods.

There is a large deposit of zirconium at Pablo Beach, Florida, but it is not being worked at present. Imports are from Brazil and India.

Silica. Silica increases the tensile strength of steel and makes it resistant to acids. Added in varying amounts, it will harden, soften, toughen, and strengthen wrought iron. It is particularly valuable in steel for springs. Slight amounts improve brass and add to the conductivity of copper wire. It is also used to make bricks for furnace linings in the manufacture of steel.

Pennsylvania, Wisconsin, and New Jersey are the leading producers.

Magnesite. As an alloy with steel, magnesite is valuable where light weight must be combined with strength. Its chief use, however, is as a refractory material in lining open-hearth and electric furnaces, and furnaces for refining lead, and in the equipment used in converting copper. Second in importance is its use in making Sorel cement, which is used in sanitary flooring, wall plaster, and for forms of exterior construction which must be set rapidly and be strong. Other uses are in the sulphite process for making paper, in fire-resisting paints, as a nonconductor of heat in pipe and furnace coverings, and in some chemicals.

There are many deposits of magnesite, but only a few are used much. Immense deposits are found in Washington, and smaller ones in Nevada and in California on the west slopes of the Sierra Nevada Mountains. The U. S. S. R.[3] leads the world in production, and Austria is second.

Industrial importance of the ferro-alloys. It would be difficult to estimate the industrial importance of the ferro-alloy metals. Modern industry could not exist without them. Our great bridges, streamlined trains, the electrical and automobile industries, and others would be impossible without them. The manufacture of automobiles at a low cost is the result of a standardized product made by mass methods of production. Interchangeable parts are essential to this, and they are impossible on a large scale unless there are efficient tools for fashioning them. Alloy steels, there-

[3] "U. S. S. R." is used throughout this book in place of the longer name, "The Union of Soviet Socialist Republics."

fore, have an importance that is far out of proportion to the small quantity produced or the small total value compared with that of the major metals.

Because of the essential part they have in industry, especially in the manufacture of special steels and other metals needed in time of war, the alloy minerals are often called key minerals. The possession or control of supplies thus becomes important. The deposits of such minerals are widely scattered, no single country possessing important reserves of more than a few within its boundaries. The United States lacks extensive supplies of all but molybdenum. One must remember, however, that some of our large mining companies have expanded their activities into foreign countries, thus bringing supplies of some of these metals under American commercial control.

Of the alloy steels, stainless steel is probably the best known. It is a chromium-nickel alloy and resists corrosion so well that it may be used so extensively at some time that millions of dollars will be saved annually. It is now important in the manufacture of cutlery, containers for canned foods where resistance to acids is desirable, equipment for restaurants and dairies, and the apparatus of chemical plants.

Cor-Ten is the trade name of a new light, high-tensile, rust-resisting steel which may be used in making railway equipment in the future. The president of one of our large railway companies recently estimated that if freight cars could be made 25 per cent lighter, $154,000,000 annually could be saved in operating costs. The trains could make greater speed, there would be less wear on the track, and less fuel would be required.

Another urgent problem is to obtain higher pressure and temperatures in steam engines, the principal method by which the cost of power may be lowered. Steam boilers explode because the steel of which they are made stretches. Though we are now using steel which withstands greater pressure and higher temperatures than that employed a decade or so ago, the need for much improvement still exists. An alloy steel called *izett* has the great-

est tensile strength of any that has been developed, but it is too costly to be applied extensively.

The list of alloy steels might be extended still more, but enough has been said to indicate the progress made and the nature of the problems which await solution. It has been stated that the cost of some alloy steels is yet too great for extensive use. It should be recognized, however, that they would not need to be as cheap as ordinary steel to find large markets. This is because they lower the cost of production of some products, and in all cases are more durable than ordinary steel, not having to be replaced so often.

5
THE NONFERROUS MINERALS

THE minerals discussed in this chapter may be divided into two broad groups: metallic and nonmetallic. In the former group are the major nonferrous metals—copper, lead, zinc, aluminum, and tin; the precious metals—gold, silver, and platinum; and mercury and arsenic. The second group includes the fertilizer minerals—nitrate, phosphorus, and potassium; and a miscellaneous list including mica, asbestos, graphite, sulphur, and salt, several of which are important in the automotive, electrical, and chemical industries.

A. Metallic Minerals

Copper. Copper was probably the first metal used by man, but it has been used in large quantities only since the rise of the electrical industry. Recently, 15 tons of copper wire were used in constructing a single transformer. This metal is used extensively in the electrical industry because of its conductivity and cheapness, the latter resulting from the relatively low cost of extraction from the ore. Copper, which alloys well with other metals, is used much in making brass, a mixture of copper and zinc, and bronze, a mixture of copper and tin. No satisfactory substitute has ever been found for bronze as a bearing metal. Copper is also used extensively in munitions and ordnance.

Copper ores are distributed widely, but are found in paying quantities in relatively few places. There are five important centers of production in the United States: the southeastern part of Arizona and adjacent parts of New Mexico, the Bingham

district of Utah, eastern Nevada, the Butte area of Montana, and northern Michigan.

The copper reserves of the United States which could be mined for less than 12 cents a pound were estimated in 1935 to be 26 million tons. This is about a quarter of the world reserve.[1]

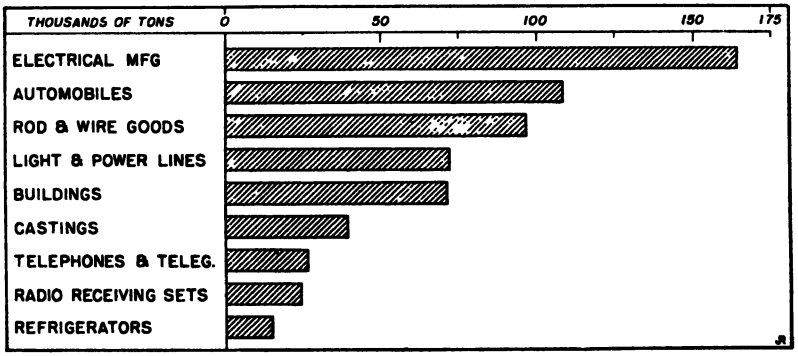


Fig. 27. Principal uses of copper in the United States in 1936.

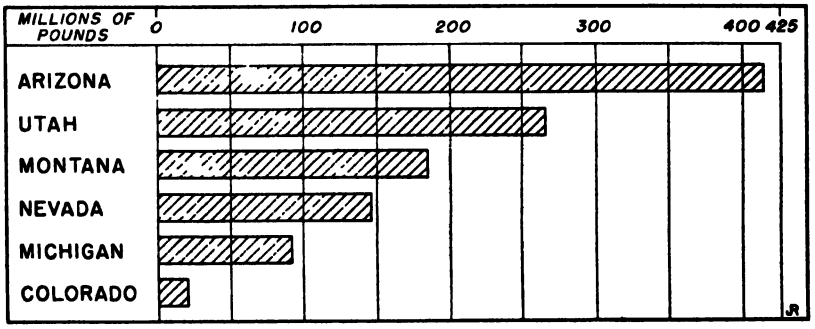


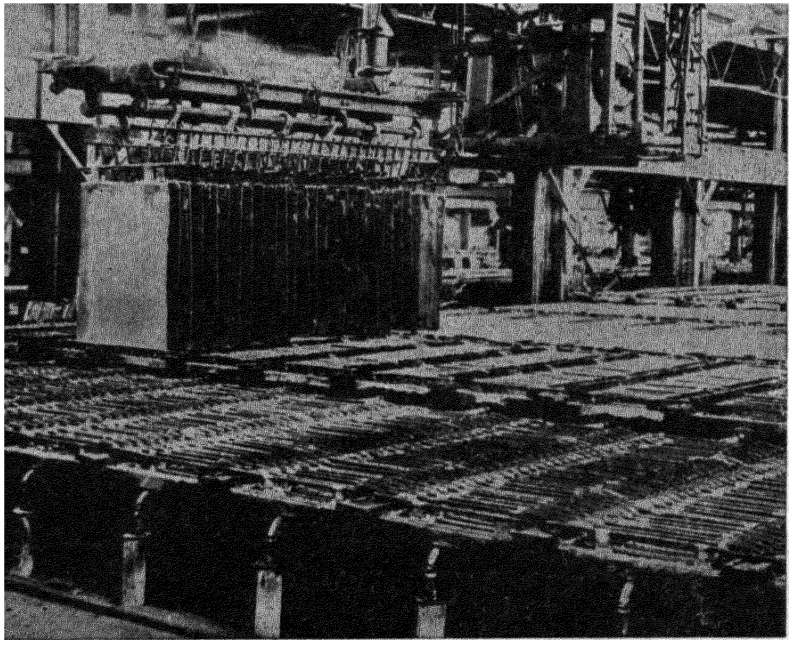
Fig. 28. Leading states in the production of copper from domestic ores in the United States in 1936.

Copper may occur as native copper, or, as is more commonly the case, in ores, in most of which the copper is combined chemically with other elements. The principal types of ore are oxides, a combination of copper and oxygen, and sulphides, a combination of copper and sulphur. Other minerals are also commonly associated in the ores. The different methods of occurrence require

[1] *Mineral Yearbook*, 1936, p. 110.

variations in the smelting process. At present the sulphide ores are more economically important than the other types.

The copper content of copper ore ranges from 10 to 1,500 pounds per ton. The average for the United States is now about 28 pounds. Here, the high-grade ores have been depleted and the industry is now dominated by large corporations which can make



Anaconda Copper Mining Co.

Fig. 29. Removing fine copper cathodes from solution.

a profit by owning large bodies of ores of low copper content and by working them with scientific methods and large machinery. This requires large capital resources.

In preparing copper for manufacture into finished products there are two processes, (1) smelting of the copper ore and (2) refining the end product of the smelting process. In smelting there are two steps, (1) the making of copper matté, which is from 35 to 50 per cent pure, and (2) the making of blister copper, which is from 96 to 99.5 per cent pure. First, the ore is roasted

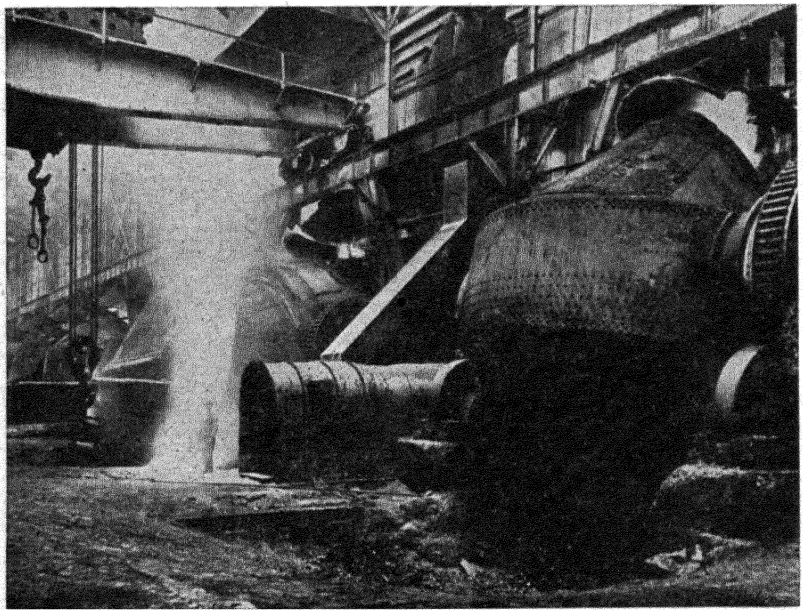
to drive off excess sulphur and other products. It then fluxes, when mixed with limestone or silica. When molten, the copper settles to the bottom with some sulphur. It is then drawn off and allowed to harden into matté. The matté is then heated, and most of the sulphur passes off as a gas, the resulting product being blister copper. In this condition it also contains some precious metals, which are recovered when the copper is further refined by electrical processes. The average value of the precious metals recovered in this country is 40 cents per ton of copper ore. Not all copper needs to be refined, but when it is used for electrical wire, it must be almost pure because the impurities reduce conductivity. For some other uses the impurities are an advantage.

The smelting of copper is usually carried on near the mining center because of the great cost of transporting ore of low copper content for long distances. The large mining companies have their own smelters, but there are many custom smelters which buy their ore, usually from small mining companies which do not operate smelters. The smelted product is valuable enough to be shipped to other centers for refining. Refining is usually done near the markets for copper, which as a rule are distant from smelting centers. The average refinery has about two and one half times the capacity of the average smelter, and thus usually refines for several smelters.

The leading refining center is along the Atlantic seaboard, chiefly at Baltimore and in the vicinity of New York City. These places, near coal and the great industrial markets, are located favorably for importing from foreign smelters and exporting the refined product. Another center is at Hubbell, Michigan. It supplies the industrial market of the Chicago area. There are four refineries in the West—at Great Falls, Montana; El Paso, Texas; Clifton, Arizona; and Tacoma, Washington, the latter refining copper from Alaska. These centers supply the western and the Oriental markets. From 30 to 50 per cent of the copper refined in the United States is exported, chiefly to northwestern Europe, the exports being largely from copper imported for refining.

The United States is declining in importance as a refiner of copper, owing to the rise of the U. S. S. R. and the Belgian Congo as producers of the metal.

Lead. Lead is prized chiefly because of its malleability and its resistance to corrosion and the action of certain acids. Next to iron, it is the cheapest of all metals, and likewise has a greater diversity of uses than any other metal except iron. On account of its cheapness it is used extensively instead of the more expensive



Anaconda Copper Mining Co.

Fig. 30. General view of converter floor in a copper refinery.

metals. Its extensive use is principally due to the demands of the automotive and the paint industries.

Lead is used both as a metal and in chemical compounds. As a metal it is made into sheets, pipes, cable coverings, and various alloys, such as solder, pewter, babbitt metal, type metal, and metal for bullets. In compounds lead is used chiefly for paints. Lead might be used in much greater quantities if some foreign countries did not prevent its use by law, in order to protect people from lead poisoning.

Most deposits of lead ore occur in limestone, where lead and zinc are usually associated. The only important lead deposit that does not contain zinc in paying quantities is the one in southeastern Missouri, which is our leading district. The next ranking district is at Coeur d'Alene, Idaho. Minor centers are at Joplin, Missouri; Butte, Montana; Bingham, Utah; and Leadville, Colorado. With its two districts, Missouri is the chief producing state. The mineral authority, J. R. Finlay, has estimated that our reserves of lead will last for about 15 years. One must remember,

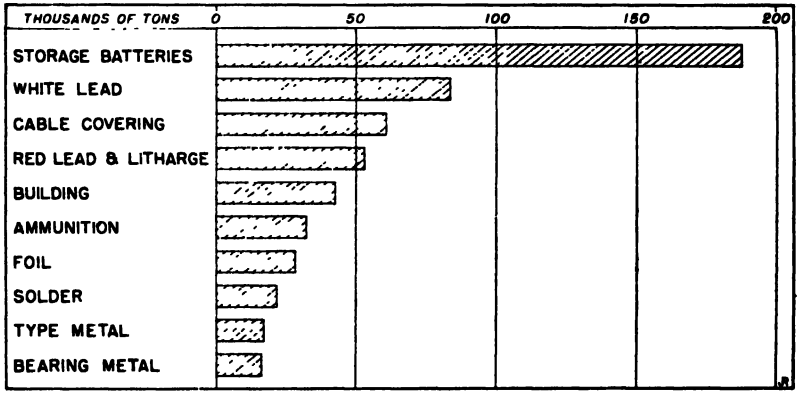


Fig. 31 Principal uses of lead in the United States in 1936

however, that as lead or any other product is gradually used, the price becomes higher, which makes it necessary to use substitutes and to limit the use to the more essential purposes. A higher price thus reserves supplies for those industries which can afford to pay the higher price.

Like copper, lead is both smelted and refined. Since the ores usually have a low metal content—those of southeastern Missouri average but $3\frac{1}{2}$ per cent lead—and since little fuel and little skilled labor are required, much smelting is near the mining centers. Some smelters, however, locate near the source of the power or near the market for the lead, if cheap transportation is available for the ore. Refining is also usually done at such centers. There are also smelters such as the ones at Indianapolis and Cleveland,

which smelt only secondary lead, largely from old storage batteries. They are near both their raw material and the market for the refined product. In smelting, the ore is usually concentrated to 50 to 70 per cent purity. This concentrate goes to a few refining centers, these usually being located where power is cheap. On the Atlantic seaboard lead is refined in the same centers as copper. The leading center in the interior is in the southern Illinois coal field. Omaha, Nebraska, does both smelting and refining, having one of the largest smelters in the country. In

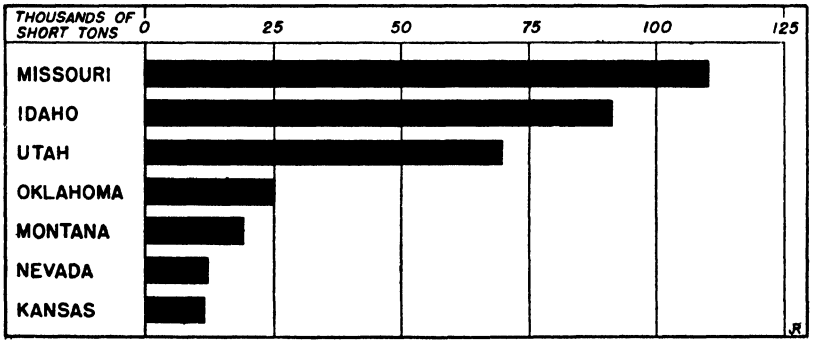


Fig. 32. Leading states in the production of recoverable lead in 1936.

the West, Midvale, Utah, is important; Tacoma and San Francisco are the coastal centers. Normally there are important imports of lead from Mexico.

Zinc. Zinc is one of the most widely distributed of metals, usually occurring in combination with lead. Its important assets are malleability and resistance to weathering. Like lead, it is used both as a metal and in chemical compounds. The chief uses as a metal are for galvanizing sheet iron, which consists in giving it a thin coat of zinc to prevent rusting, and in making brass; the former use normally consumes about 60 per cent of the output, the latter 20 per cent. In chemical compounds an increasing amount is replacing lead in paints, while zinc chloride is used to treat wood to prevent decay.

The leading center for the production of zinc ore is the Tri-state district centering around Joplin, Missouri. Others are at

Coeur d'Alene, Idaho; Butte, Montana; Mascot, Tennessee; Franklin Furnace, New Jersey; and in southwestern Wisconsin and northwestern Illinois. The reserves of zinc are large, contrasting in this respect with those of copper and lead.

Although smelting is not necessary for very high quality ore, the average zinc ore is only of about 5 per cent purity and must therefore be both smelted and refined. Smelting, which reduces the ore to about 45 per cent purity, has usually been done near the mining centers; but with the application of electrical processes to smelting, some smelters are being built near the power sites, particularly where cheap hydroelectric energy is available.

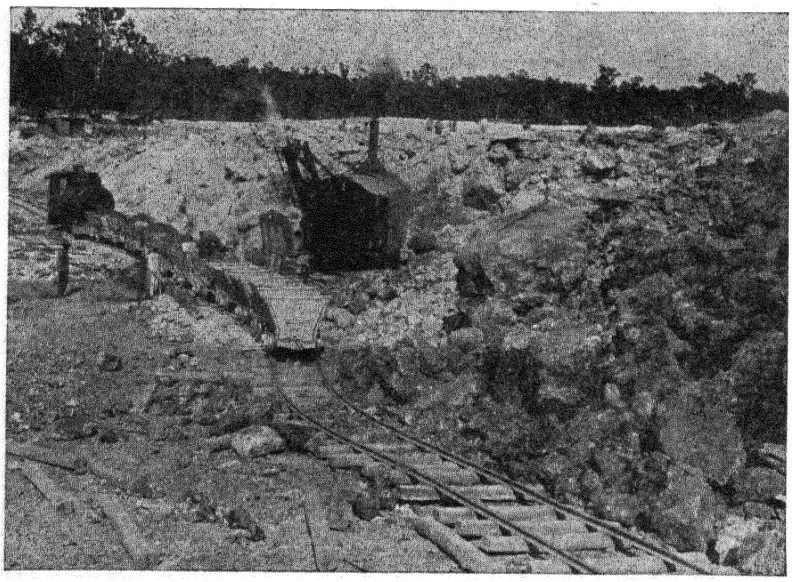
The refining of zinc usually takes place near the consuming centers, where skilled labor is available. Leading centers are East St. Louis; Monsanto, Illinois; Franklin Furnace; Columbus, Ohio; and Great Falls. Columbus obtains its concentrate from Mascot, Tennessee. Hydroelectric energy is employed at Great Falls.

Aluminum. Aluminum, one of the newer metals of commerce, is obtained from the ore bauxite. The element aluminum is abundant in the rocks of the earth, but thus far bauxite yields to treatment at lower cost than do other aluminum compounds. Its assets are lightness, strength, and ability to resist rust. According to the United States Geological Survey, aluminum rivals iron in strength, weight for weight, and might be an important substitute for iron if the quantity of power needed to extract it from its ores were not so much greater than that required by iron.

The first important use for aluminum was in the manufacture of kitchenware. It was next made into alloys for parts of automobiles and airplanes, and was used as a substitute for copper in wire and brass. It has recently been used as a structural material in bridges and buildings, in the manufacture of railway cars, for tanks and barrels in breweries, for excavating and loading equipment, and for paint. An aluminum brewery barrel weighs only 18 pounds, compared with 70 pounds for a wooden one, holds more, and requires less space for storage. Excavating and load-

ing equipment of aluminum construction will make 60 loads per hour, compared with 40 loads for the older type of equipment. The use of aluminum paint has doubled during the past decade. Many large bridges are now painted with it.

Ninety per cent of the bauxite mined in the United States is from central Arkansas. Another field is at the junction of Tennessee, Georgia, and Alabama, and another in central Georgia. That



The Republic Mining and Manufacturing Co.

Fig. 33. Open-pit mining of bauxite in Arkansas.

from Arkansas is used for making metallic aluminum; that of the other fields for aluminum salts. The deposits of Arkansas are the largest and are about 35 feet thick. Open-pit mining is employed in all of the fields.

There are two steps in the refining of aluminum: (1) the extraction, by chemical means, of alumina from the bauxite, and (2) the extraction of aluminum from alumina in an electric furnace. Two pounds of bauxite are required to obtain one pound of alumina, and about two pounds of alumina for one pound of aluminum. Because of the cheapness and bulk of the bauxite,

alumina is usually extracted near the ore deposits unless cheap water transportation is available. East St. Louis is the leading center for this. Bauxite which comes from British and Dutch Guiana by way of the Mississippi River is also treated there. The alumina is sent to places where cheap hydroelectric energy is available. Massena and Niagara Falls, New York; Badin, North Carolina; and Alcoa, Tennessee, are the leading centers. The plant at Massena refined 41 per cent of the alumina in 1936, the one at Alcoa, 30 per cent.

Tin. Tin is the rarest of the common metals of commerce. Although it exists in small deposits in various parts of the United States, not over 1 per cent of the domestic consumption is from domestic sources. Tin has been used by man almost since he first started to work metals, the earliest uses being in bronze and munitions. It is now used largely for the manufacture of *tin plate* for food containers. The tin added to the thin steel plate does not amount to more than 2 per cent of its weight. The tin protects the iron against rust and is itself unaffected by the contents of the container. Other uses are in *terne plate* (a mixture of tin and lead), solder, babbitt and other bearing metals, collapsible tubes, foil, white enamel, and in weighting silk. Substitutes are available for most of the uses except in tin plate and bronze.

Except reclaimed tin, almost all the tin used in the United States is imported from British sources. Bolivia, an important source of tin ore, ships its output to the Bay of Bristol ports of Great Britain for refining. Even the small output of tin ore in Alaska is shipped to British Malaya for refining.

THE PRECIOUS METALS

Gold and silver. Because of their close association, both in use and in geological occurrence, gold and silver are here discussed together. Their use in coinage is familiar to all; bars of each metal are used in making international payments. Both metals are used in jewelry, plated ware, and chemicals, and silver is important in the manufacture of photographic film, which finds its

principal market in the moving picture industry. Newer possible uses for silver are for purifying municipal water supplies and for the rapid aging of liquors.

Gold and silver are usually associated in ores which also contain other minerals. Much of the production of both is a by-product of ores which contain pyrite, lead, zinc, or copper. Lead-silver ores are the most important. In the United States all gold mines produce some silver, and nearly all so-called silver mines produce some gold. In 1936 only four mines in the United States were operated primarily for silver. Rich ores contain 4 or 5 ounces of gold and 1,000 ounces of silver per ton. Most ores in the United States, however, now return from $\frac{1}{10}$ to $\frac{1}{2}$ of an ounce of gold, and from $\frac{2}{3}$ of an ounce to 7 ounces of silver per ton. Lead-silver ores usually have from 5 to 50 ounces of silver per ton.

Gold and silver are found in placer deposits, in veins, or scattered throughout large bodies of ore. Placer deposits are found in stream beds and lowlands where they have been washed down from the mother deposits in the highlands. Placer deposits are usually worked in the early days of a gold field because they are more accessible and more easily and cheaply worked than the others. When the placer workings are exhausted, the deposits in the highlands must be sought.

Gold and silver are usually recovered from their ores by amalgamation or cyanidation, the latter process being newer and more important. Some ores which cannot be treated by these processes are smelted.

In recovery by amalgamation, the finely crushed ore is passed over plates coated with mercury, the metals amalgamating with the mercury. This amalgam is then scraped off the plates and heated, the mercury passing off as a vapor. With the cyanide process, the crushed ore is leached in tanks containing a solution of sodium or potassium cyanide, which dissolves the precious metals. They are later precipitated on zinc shavings or zinc dust. In smelting, the gold and silver are contained in the baser metals

which are extracted, being afterward reclaimed from them by refining.

Gold and silver are mined in most of the states of the mountainous West. The leading gold mine is the Homestake mine at Lead, South Dakota, which has been in operation since 1876. The leading silver mine is the Sunrise mine near Kellogg, Idaho, which accounted for 12 per cent of the output of the nation in 1935. The United States does not contribute a large part of the world's gold, however, averaging only 10 per cent of the total for the period 1934-1936, the same as Canada. For the same period the Union of South Africa supplied an average of 35 per cent and the U. S. S. R., 19 per cent. Postwar economic events and recent monetary legislation in the United States, however, have caused much of the world's monetary gold to concentrate in this country, helping us but little and depriving other countries of a needed commodity for monetary and commercial purposes.

Platinum. Although platinum is costly, it is nevertheless used for many purposes and is highly important in the chemical industry, having no known substitutes in the manufacturing processes of sulphuric acid and artificial nitrates. It is also used for heat- and acid-resisting utensils in chemical laboratories; for jewelry and dental materials; and in the electrical industry for contacts in communication equipment and magnetos, and for electric controls of heat in ovens and furnaces. In the electrical industry, however, it is being displaced by some of the ferro-alloy metals.

The negligible production of this country is from the Pacific coast, where it is recovered in dredging for gold, mainly in the foothills of the Mother Lode area in California. Imports are largely from the U. S. S. R., Canada, and Colombia.

MERCURY AND ARSENIC

Mercury. Mercury, obtained from the mineral cinnabar, has a multitude of uses but is employed mainly in making drugs and

chemicals and detonators in high explosives, and for extracting gold from the ore, to which reference was made earlier in this chapter. Unlike most other metals, the ores are treated at the mines in either furnaces or retorts, and the finished product, a liquid, is shipped in iron or glass containers.

The small domestic production is centered in California, and comes from ore of only .38 of one per cent purity, which is the poorest that is mined successfully anywhere. Our reserves are rapidly approaching exhaustion. Imports are nearly altogether from Italy and Spain.

Arsenic. Arsenic is a constituent of about 130 minerals, and is usually mined as a by-product. The greater share is consumed in agriculture for insecticides, dips for animals, and weed exterminators. Another important use is for hard lead in shot and bearing metal.

Domestic production is largely a by-product of copper smelting at Butte and of the smelting of gold-silver ores at Tintic, Utah. It is mined alone at Brinton, Virginia, and in New York. The reserves of the nation are large.

B. Nonmetallic Minerals

FERTILIZER MINERALS

Importance. Plants require several different foods, but the ones of most commercial importance are phosphorus, potassium, and nitrogen, which have their natural sources, respectively, in phosphate rock, potassium salts, and nitrates. Some soils may have been lacking originally in one or all of these elements, or they may have been removed by leaching and cropping at a faster rate than they were replaced by natural processes. Some soils have sufficient phosphorus and potassium to last indefinitely, but they are removed more rapidly than natural processes can make them available for plants. The soils of rainy areas are particularly in need of fertilizer if they are to be used profitably for crop pro-

duction. This is true in the eastern United States, where the land has been cultivated for a long time. The dense population creates a heavy demand for food, much of which can be grown more cheaply, even with a heavy expenditure for fertilizer, than it can be transported from a distance. Because of this fact, the Eastern States manufacture and consume about 85 per cent of the total output of commercial fertilizer. Large quantities are manu-

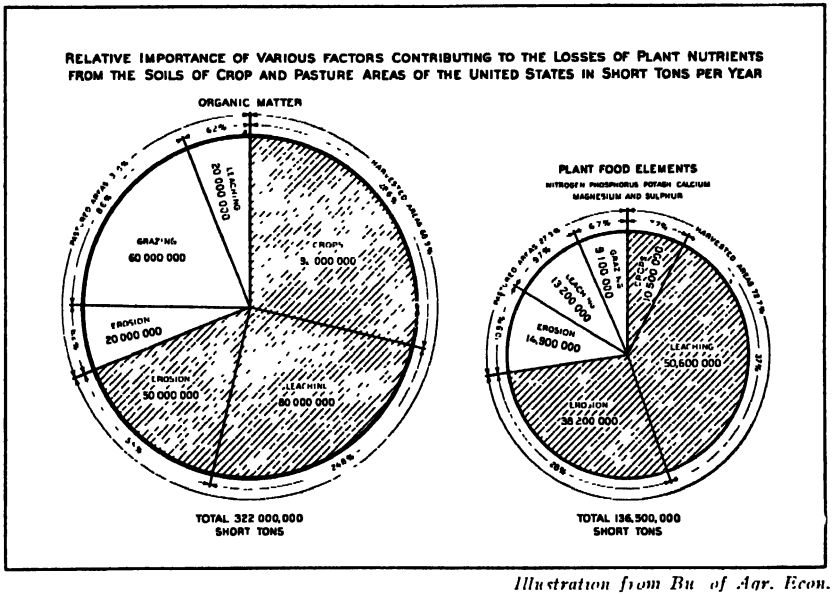


Illustration from Bu of Agr. Econ.

Fig. 34. Losses of plant nutrients from the soil.

factured in the seaports of the region, because a considerable amount of the raw materials are imported.

Functions. Each of the three plant foods has its own special effect on the growth of plants. Phosphorus is important in the maturing, fruiting, and ripening of crops. It is lacking in many soils, especially those of our Midwestern States. When potassium is lacking in the soil, the leaves of the plants are brown and unhealthy, the stems become weak and brittle, and plants are more susceptible to attacks of fungus diseases. Potassium is important in making fleshy fruits of full flavor and texture. It is needed

especially for muck soils and for those on which we grow cotton, tobacco, potatoes, and citrus fruits. Nitrogen has an influence on the vegetative growth and color of plants. Its presence may be detected by the rank growth and dark green color of many plants. In our Southeastern States, it is the most needed plant food.

Phosphorus. Phosphorus enters into fertilizer mixtures in the form of phosphoric acid, which is made by digesting phosphate rock with an equal portion of sulphuric acid. Acid phosphate is the trade name of the resulting product, and it is a constituent of most artificial or mixed fertilizers. A small amount of phosphate rock is ground and applied directly to the soil, but this method is not very successful.

Deposits of phosphate rock are found in many places. Our Southeastern States produce nearly half the world's supply, Florida supplying 80 per cent of the domestic production, and Tennessee most of the remainder. The deposits of Florida, in the form of stones and pebbles mixed with sand and clay, are near Tampa. They are mined both by steam shovels and dredges, and by hydraulic methods. In screening and washing the rock, immense deposits of tailings have accumulated. The flotation process has been introduced recently as a method of treating phosphate rock. This permits double the recovery of the previous method, and will make possible the reworking of the old debris dumps. The federal program for developing the Tennessee River Valley involves the exploitation of several thousand acres of phosphate-bearing land.

The Western States, especially Colorado, Utah, and Idaho, have immense deposits, but they are too far from the principal markets to be worked extensively at present. These deposits are in the form of hard rock, which must be mined by underground methods. The leading centers of production at present are Conda, Idaho, and Garrison, Montana.

Minor sources of phosphorus are the bones and tankage of

animals in the meat-packing industry, guano, and basic slag from the steel industry.

From 40 to 50 per cent of our output of phosphate rock is exported; Germany is the leading market, followed by the Netherlands, Japan, Sweden, and Italy.

Potassium. The principal use for potassium, which is sold under the trade name of potash, is in commercial fertilizer. This element exists widely in nature, but to be available as plant food it must be soluble in water, and most of the supply is in insoluble combinations. Potash may be obtained from three sources: rocks, salt lakes or soluble deposits, and plant materials. The first supplies were taken from wood ashes, this being a way in which our colonists made some commercial use of the abundant forests which they found here. Almost the entire production now is from solid beds of soluble salts.

Until recently, because of the high cost of working the domestic deposits of potassium salts, we have depended on foreign sources. But with the experience gained in exploiting domestic supplies during the World War, and because of newly discovered deposits and world economic dislocation, we are now supplying almost half of the domestic demand.

There are several sources of supply in a number of salt lakes and underground deposits in the West, and in shales and rock in both the West and the East. Our reserves, 90 per cent being in the West, have been estimated to be twenty times as great as our reserves of phosphate rock. Our entire production now is from underground deposits in the Southwest and Searles Lake in California. In the latter, where borax and other by-products help defray the expense, the estimated reserves are sufficient to supply our total requirements for 80 years at the present rate of consumption.

Underlying the region from central Kansas southwestward into New Mexico is a great salt basin similar geologically to the great deposits of central Europe. Prospecting has disclosed that near

Carlsbad, New Mexico, at a depth of 1,000 feet, are deposits which are twice as rich in potassium as are those of Europe. Two mines are now in operation in this district, and preparations are being made to expand the industry. All of the important companies operate on land that is leased from the Federal Government. Existing plants could be enlarged sufficiently to meet all domestic requirements.

Potash may also be obtained as a by-product from the dust of cement mills, from slag from blast furnaces, and from residue from molasses distilleries and beet sugar refineries. Almost 50,000 tons might be recovered annually from the latter two sources. With the installation of the proper equipment, which is somewhat expensive, as much as 380,000 tons might be obtained from blast furnaces, and cement plants could supply 100,000 tons. That recovered from cement mills has the lowest cost of any, being even lower than for the German deposits, but its quantity is limited by the amount of cement produced.

Nitrogen. The chief natural source of nitrogen is salts which are used principally in the manufacture of fertilizers and explosives. These salts are a major material in explosives, and many of the combinations used in this industry may be used, either directly or by a slight transformation, in fertilizers. Other uses are in the manufacture of ammonia (for refrigerating plants), sulphuric acid, potassium nitrate, glass, dyestuffs, and nitric acid for chemical industries.

Nitrogen comprises about 80 per cent of the volume of the atmosphere, and natural processes are constantly forming ammonia and nitrate, which are carried into the soil by rain and snow. Leguminous plants draw nitrogen from the air and store it in the soil, and there are certain organic wastes, such as cottonseed, tankage and dried blood from slaughterhouses, and fish scrap, which contain nitrogen. But these sources cannot replace the quantity drawn from the soil.

The chief sources, all organic, are by-product ammonia (obtained from coke and gas ovens), and Chilean and manufactured

nitrate. The latter source supplies the greater amount, and progress in its manufacture has recently been rapid. Germany leads in the manufacture of nitrate and of late has been exporting in competition with the natural supplies. The only important source of natural nitrate is the Atacama Desert of northern Chile, where enormous but not inexhaustible deposits are found.

Because of the great amount of energy required in the processes, nitrate can be made from the air only where there are large-scale hydroelectric developments, as at Muscle Shoals or Niagara Falls. The processes of manufacture are too complex to be discussed in detail here, but they consist essentially in combining the nitrogen of the air with calcium or sodium, according to the particular process used, under great heat to form various products which can be used in fertilizers.

There are three important methods. In the arc process, nitrate of lime is made by using lime to treat the nitrogen which results from passing air through a high-temperature electric arc. Because of the large power consumption of this method, it is used chiefly in Norway. In the cyanamide process, calcium cyanamide is made by employing calcium carbide and nitrogen at high temperatures. In the synthetic-ammonia process, which is the newest and most important, hydrogen and nitrogen are made to combine at high temperatures in the presence of a catalyzer to form ammonia. The ammonia is easily transferrable into a number of salts.

OTHER MINERALS

Mica. Although mica, a constituent of most rocks, is one of the commonest of minerals, earth movements have broken up most deposits and rendered them worthless for sheet mica, which is the most valuable variety. The mining of mica is more speculative than that of any other mineral, because its occurrence is irregular. There are no rules to guide the prospector. The mines are usually small.

Mica is used either in the form of sheets or as ground mica.

The latter is made from the scrap left from making sheets or from deposits that do not split into sheets. Large sheets are made by pressing smaller ones together with shellac.

At one time sheet mica was used chiefly in the sides of stoves. Because it is highly resistant to heat, it is now employed chiefly in the electrical industry. In wireless equipment a sheet one thousandth of an inch thick must withstand 20,000 volts. Thin sheets are used as diaphragms in radios, loud-speakers, telephone transmitters, and phonographs, where flexibility and uniform thickness make possible the transmission of sound waves. It is also used in stone and metal workers' goggles and in the windows of fuses. There are no good substitutes for most of the purposes. Some ground mica is used for insulation, but its chief employment is in roll roofing and composition shingles.

The United States is self-sufficient in ground mica, which comprises 95 per cent of the domestic production of mica, but must import 75 to 80 per cent of its consumption of the sheet type. North Carolina contributes slightly more than 60 per cent of the ground mica, followed by New Hampshire. Much is obtained as a by-product of the feldspar industry. Imports of sheet mica are largely from British India, Ontario, and Quebec.

Graphite. Graphite, a form of pure carbon, is of two types: crystalline and amorphous. The latter type is usually found where coal has been metamorphosed; the crystalline is associated with igneous processes and occurs either in veins or in flakes in rocks; the crystalline is more valuable. About equal amounts of crystalline and amorphous are consumed. Forty per cent of the amount used in this country is for foundry facings, and twenty per cent for crucibles in which to refine metals. For crucibles, the crystalline variety must be employed, for no satisfactory substitute has been found. For other uses, the amorphous is as good as the crystalline. Small quantities of graphite are made into lubricants, lead pencils, paints, and stove polish. Mica, though inferior, may be substituted for graphite in lubricants.

In pencils, graphite is mixed with clay in proportion to the hardness desired. Vein graphite may be concentrated by hand and by simple mechanical methods; the other requires crushing or flotation, or both.

The only domestic deposit of crystalline graphite of good quality is a small one in Montana. There are many scattered deposits of the amorphous type, but production is negligible. For most purposes either the imported graphite from Ceylon and Madagascar or artificial graphite is cheaper or better than the domestic. Artificial graphite, manufactured from either anthracite coal or petroleum coke by a large plant at Niagara Falls, may be substituted for the amorphous variety. The principal use is in electrodes for electric furnaces.

Asbestos. Asbestos is really a mineral fiber, but the term includes several minerals of varying characteristics. Most of the production is from chrysotile, which is stronger and more flexible than any other variety. It is highly resistant to the effects of heat and chemicals, and is also a good nonconductor of heat and electricity. It can be spun and woven. The longer fibers are made into fabrics, ropes, engine packing, and brake linings. The leading use is for brake linings for automobiles. Short fibers are used for cement, shingles, lumber, millboard, pipe coverings, and paints. Asbestos is spun into a yarn by mixing it with cotton or by twisting with brass or copper wire, the wire adding to its strength and life. The yarn is then woven and the fabric made into theater curtains and gloves; when coated with rubber, the cloth is used in the manufacture of gaskets and high-pressure steam packings.

Although several states, among which are Georgia, Arizona, and Vermont, contain deposits of asbestos, the bulk of our consumption is from near the Vermont border in Canada.

Sulphur. Sulphur, the brimstone of the Bible, exists in many mineral ores and in all meats and plants. Of these sources, only a few of the mineral ores are exploited, and only one, native sulphur, is mined exclusively for the purpose of obtaining sulphur.

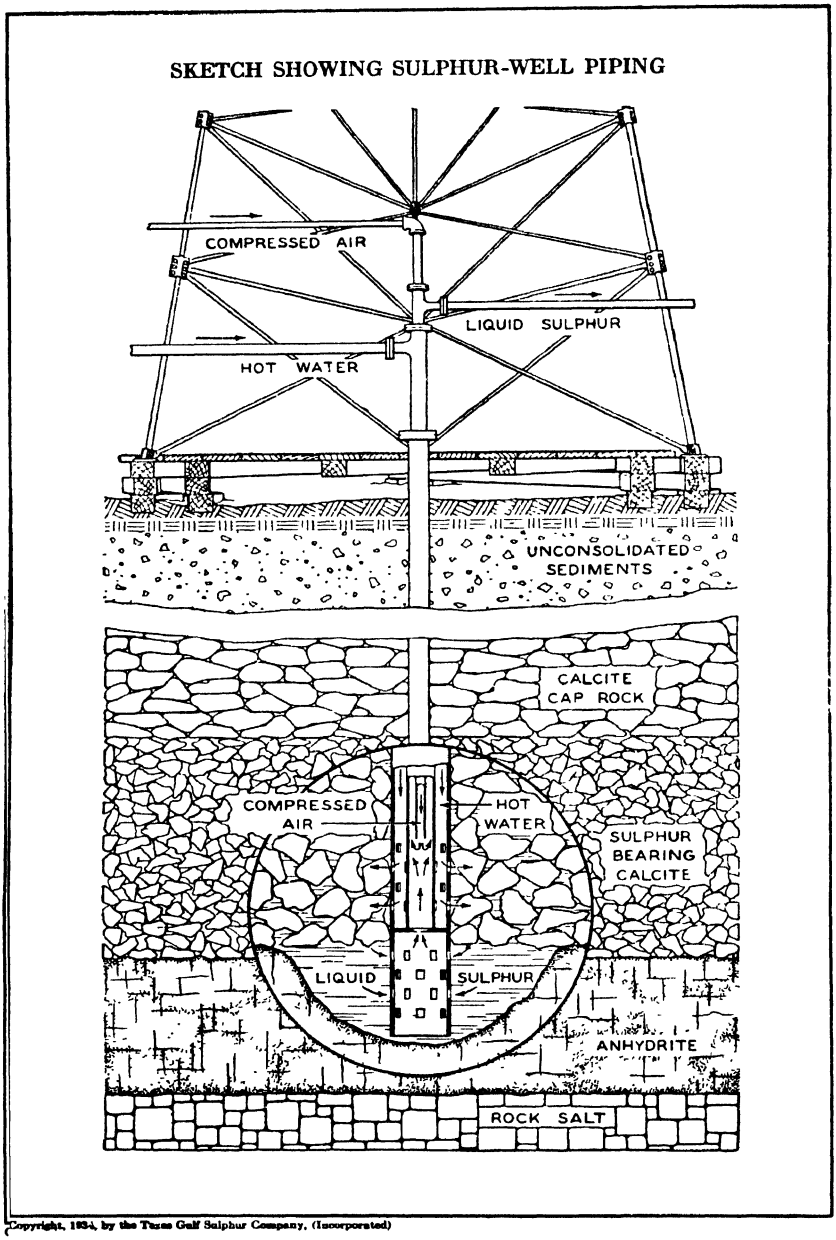


Fig. 35. Sulphur mining.

The principal uses of sulphur are for the manufacture of sulphuric acid and paper pulp. Sulphuric acid, which consumes about two thirds of the total production, is our most important chemical raw material, and is employed for many purposes, which are discussed in Chapter 20.

The principal commercial sources are deposits of native sulphur and by-products from the smelting of copper. Nowhere else do deposits of sulphur occur in such large and easily obtained quantities as along the Gulf coast in Calcasieu Parish in Louisiana and in Matagorda and Brazos counties in Texas, where they occur in domes, in association with salt and gypsum, at depths ranging from 400 to 1,600 feet.

In mining, wells must first be drilled, after which the sulphur deposits are melted with water superheated under pressure, and the mixture forced to the surface with compressed air (Fig. 35). Crude oil and natural gas supply fuel for these purposes. On reaching the surface the liquid flows by gravity through pipes to large bins, where it hardens. Before being shipped, it must be broken with explosives, after which it is loaded by steam shovels into cars. In this form it is about 99.5 per cent pure. From 25 to 30 per cent of the output is exported, chiefly to Canada, Australia, northwestern Europe, and Mexico.

SALT

Salt is a compound of sodium and chlorine, leached originally from igneous rocks and carried into seas and oceans. The water of the ocean contains about 3 per cent salt; that of some salt lakes has 20 per cent or more. A dry climate and enclosed bodies of water are necessary for salt deposits. The water gradually evaporates, leaving a bed of salt. Some deposits are very thick, those of Texas and Louisiana being a few thousand feet thick; the chief deposits which are mined are about 21 feet thick. The largest known deposit in the United States, now unused, underlies an area

of 100,000 square miles beginning in eastern Oklahoma and extending westward through New Mexico.

In addition to being necessary for the existence of animal life, salt is used to season and to preserve foods. As a raw material in the manufacture of chemicals, it is used for sodium compounds, and for the manufacture of chlorine (see Fig. 123) and hydrochloric acid. Minor uses are in the manufacture of glass, pottery, enamelware, bleaching mixtures, and soap, and in smelting silver.

Salt deposits are distributed widely over the world but are mined extensively in only a few places. The United States, with Michigan, New York, Ohio, Kansas, and Louisiana producing the greater part of the supply, contributes about 20 per cent of all the salt consumed in the world. The first two states each produce about 25 per cent of the national output, Ohio 16 per cent, Kansas 8 per cent, and Louisiana 6 per cent.

Because of the relative importance of the demand for domestic purposes, the production of salt is stable, and is now at the rate of about 8 million tons annually. About 25 per cent of the output is mined through shafts; 50 per cent is produced by dissolving salt deposits with water and then pumping the water to the surface and evaporating it; and the remainder is produced by evaporating natural brines. The evaporating agent may be either sun, furnace, steam, or vacuum pan. Natural brines are evaporated at Great Salt Lake and at Alvarado, near San Francisco. Many chemical companies own their salt deposits, and companies owning commercial salt works sell bittern water, from which calcium chloride and bromide are recovered, to the manufacturers of chemicals.

COMMERCIAL MOVEMENT OF MINERALS

For the most part, ore deposits are not situated near the markets for refined minerals, and consequently freight charges are an important element in the cost of minerals. In the United States minerals move to the markets in the manufacturing districts of the

Northeast largely by rail. Supplies of several minerals are imported either because of lack of domestic supplies, low quality of domestic ores, or seaboard location of some factories, which makes possible the obtaining of certain foreign ores at low cost.

Of the minerals discussed in this chapter, refined copper is the leading export; tin, fertilizer materials, and blister copper are the leading imports.

6

POWER RESOURCES

MECHANICAL energy, derived from mineral fuels and falling water, has fostered modern industrial development, and man's continued welfare depends upon his ability to find increasingly efficient methods for obtaining and applying the energy contained in the supply of power resources. Man's productivity is estimated to be 100 times greater than it would be without the aid of mechanical energy.[1]

The results of the use of mechanical energy are probably more evident in the United States than anywhere else. Here, because of sparse population and abundant natural resources, there exists a machine industry on a scale not found elsewhere, accompanied by a high standard of living unduplicated in any other country. The greater the application of mechanical energy, the more is man, freed largely from a life of drudgery, given leisure time in which to do creative thinking. The goal of society should be to let machinery perform the work which requires only brawn, leaving man free to do the brain work.

Stages in power development. The first important source of mechanical power was falling water, used directly to turn water wheels. Then the invention of the steam engine and the use of coal to generate steam, which led to the Industrial Revolution, freed factories from the limitations in location imposed by the site of the water power. Coal was transportable and was obtainable in whatever quantity was desired. However, the inability of coal to bear as costly transportation as could the more valuable raw

[1] J. D. Justin and W. G. Mervine, *Power Supply Economics,* New York, John Wiley & Sons, Inc., 1934, p. 1.

materials tended to bring the raw materials to the fuel; important coal-mining centers thus often became great centers of manufacture, particularly for the industries which required relatively large quantities of fuel. Next, beginning about 1880, was the gradual growth of the use of electricity, and soon afterward the rise of the internal-combustion engine. Long-distance transmission of electricity and the interconnection of various independent power companies of a region have freed manufacturing still more from the limitations set by the location of the power resource, and have lowered the cost of power through increased efficiency in manufacturing it. Consequently, factories can now locate nearer supplies of raw material and labor, or nearer markets, and can spread more uniformly over the regions where power resources occur.

Although the internal-combustion engine cannot be installed in units large enough to make its use practicable in manufacturing, it performs important services for agriculture, transportation, and some other industries. In transportation, it contributes the major share of the horsepower installation of the nation, which was distributed as follows in 1931:[2]

Motor vehicles	85.00 per cent
Steam railways	5.56 " "
Agriculture	2.95 " "
Electric central stations	2.58 " "
Manufacturing	1.20 " "

Many persons think of power only in terms of large hydroelectric projects or central steam stations; they fail to realize that more than 90 per cent of the horsepower is in small installations in transportation equipment. This should serve to recall the statement that was made earlier in this book: that the United States is an experiment in transportation.

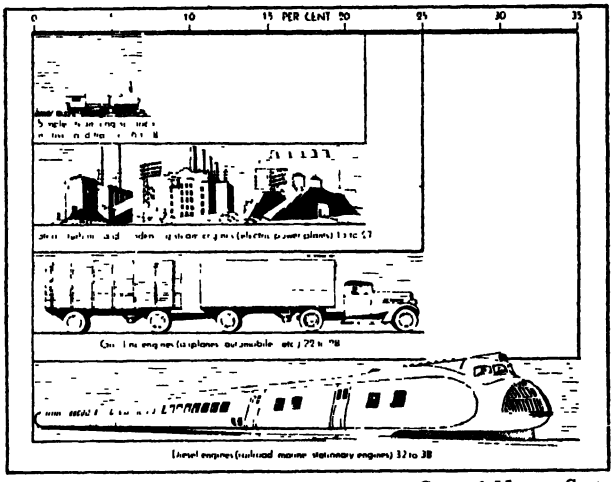
In spite of the progress made, however, there are still many problems to be solved. One is to lower the cost of transmitting

[2] Figures are from the National Automobile Chamber of Commerce and are given by N. A. Bengtson in "The Mineral Fuels," a chapter edited by A. E. Parkins and J. R. Whitaker in *Our Natural Resources and Their Conservation*, New York, John Wiley & Sons, Inc., 1936, p. 464.

electricity for long distances; another is to increase the now low average efficiency of both steam and internal-combustion engines (Fig. 36).

From this general review of the importance and the development of mechanical energy, attention must now be turned to a study of the energy resources and energy problems of the United States.

Energy position of the United States. Figure 37 creates a favorable impression with regard to the position of the United States



General Motors Corp.

Fig. 36. Efficiency of different types of engines.

in power resources. The nation does not have a high percentage of the world's undeveloped water power, but it must be remembered that most of the undeveloped water power is in the tropics, particularly central Africa, where it may never be developed. Neither are the petroleum reserves a large proportion of the estimated world reserves, but, of the reserves actually known to exist, those of the United States exceed those of any other country except possibly the U. S. S. R. In addition, there are supplies easily available in the Caribbean countries.

We do, however, have plentiful supplies of coal; this fact is important, because power for uses other than transportation will

have its source in coal for an indefinitely long time. The reasons will be pointed out later in the chapter. One must recognize, though, that the United States is using coal in much greater quantities than is any other country, and that it would be possible for a much smaller reserve to last another country as long as our large one will supply us.

Distribution of power resources in the United States. A feature of the power pattern of the United States is the wide distribution

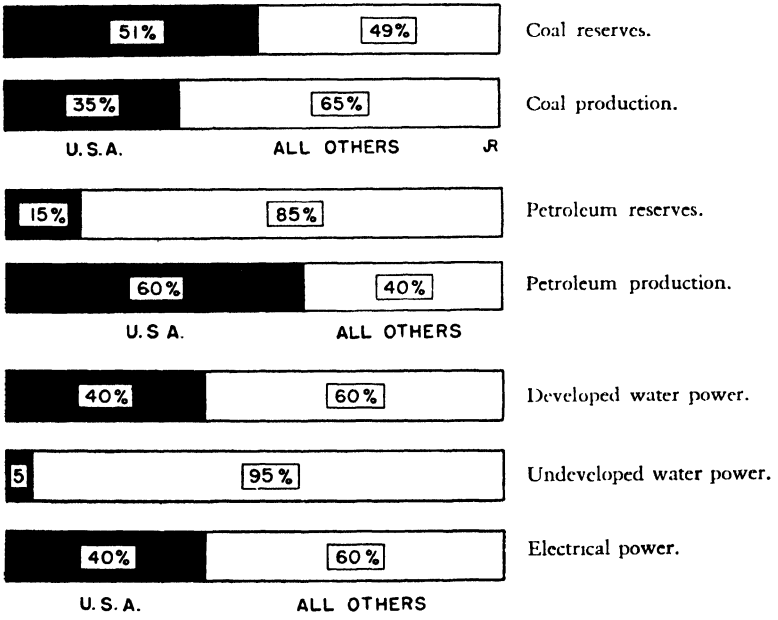


Fig. 37. Relative position of the United States in power resources and their production.

of the power resources. The different ones, with the exception of petroleum and natural gas, are not to any extent found together. Thus New England, the Piedmont, and the Pacific coast lack coal but have water power. The interior plains lack important sources of water power but have all of the fuels, although in most cases petroleum and natural gas do not occur in exactly the same districts as coal.

This wide distribution of abundant power resources has hastened economic development and has made it more uniform

over the country than would otherwise have been the case. New England early developed manufacturing. Pennsylvania coal has been a major factor in the industrial development of the nation. The coal and petroleum of the interior have aided the development of agriculture and manufacturing and have provided cheap fuel for transportation. Railways have found fuel easily available in most parts of the country, an important influence in providing

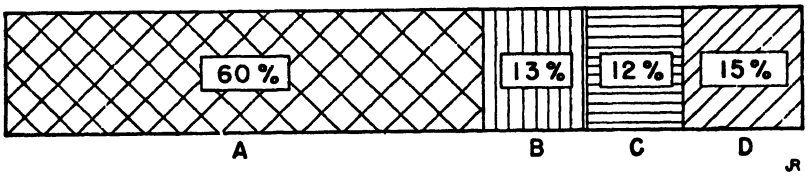


Fig. 38 Regional distribution of the coal reserves of the United States. A—Plains and western mountains, B—East, C—interior, D—others.

low-cost transportation. The petroleum and natural gas regions are largely in the southern part of the Great Plains (Fig. 49).

COAL

Advantages of coal as a fuel. Because coal has advantages not possessed by other sources of mechanical energy, it has been primarily responsible for our ability to utilize our other natural resources. Neither petroleum nor natural gas is adapted to many of our manufacturing processes, for example, to the smelting of metals. Hydroelectric energy, to be cheap, must be developed in large plants. Only recently have we had a sufficient demand for power to make large hydroelectric plants profitable. For the average or the small-scale factory, coal has usually been the cheaper source of power. The reasons for this are discussed in more detail in Chapter 22. During the past two decades, however, the consumption of coal has declined relative to that for other sources of energy (Fig. 40), a result of the development of more efficient methods and equipment for utilizing coal (Fig. 54), and of the substitution in important quantities of competing sources of energy.

Classes of coal. Coal is the fossilized remains of vegetation that has been covered with sediments the weight of which caused a change, partly structural and partly chemical. The chief agents of change were heat, moisture, and pressure. Coals are classed on the basis of their content of fixed carbon, volatile matter, moisture, and ash. Ranked according to the amount of fixed carbon, coal may be classed as lignite, subbituminous, bituminous, semibituminous, semianthracite, and anthracite. Fixed carbon, which does not smoke when burned, ranges from about 38 per cent in lignite, to 54 per cent in average bituminous coal, to 96 per cent in anthracite. Volatile matter ranges from 19 per cent in lignite, to 40 per cent in average bituminous coal, and to 1 per cent in anthracite; respective figures for moisture content are 43 and 6 and 3 per cent.

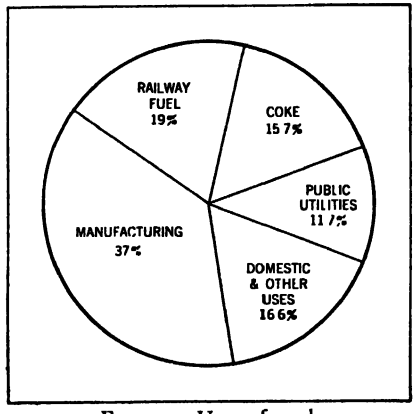


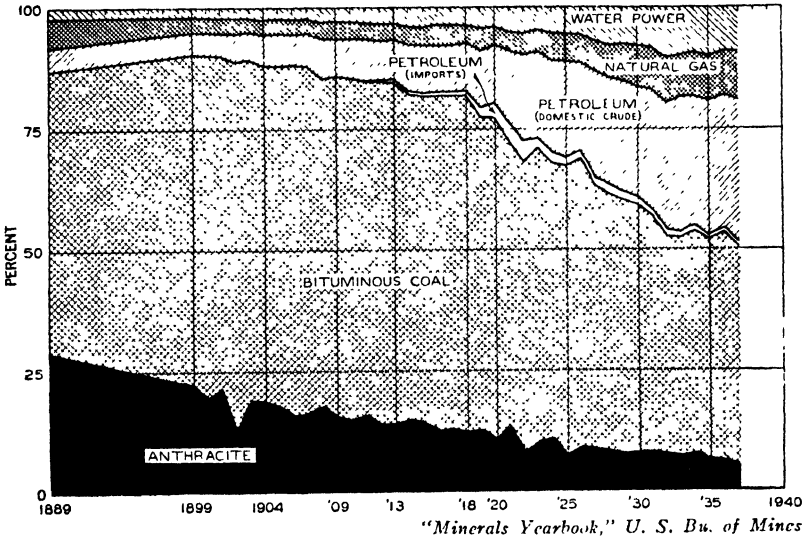
Fig. 39. Uses of coal.

Heating value is measured by the number of British thermal units (B.t.u.), a British thermal unit being the amount of heat required to raise 1 pound of water through 1°F. According to the United States Geological Survey the heating value ranges from 7,400 British thermal units in lignite to 15,400 in semibituminous coal. B.t.u. content, however, is not a measure of the value to the consumer, because it is determined under perfect conditions. The actual efficiency of utilization for most kinds of coal is usually only about 50 to 60 per cent of these ideal figures. In addition, there are usually several varieties of coal within any single class, and, consequently, figures of B.t.u. content, such as those given here, represent only a typical variety of each class.

The high moisture content of lignite and subbituminous coal lowers their fuel value and increases the danger of spontaneous

combustion when stored. Coals with a high percentage of volatile matter are excellent for manufactured gas; those with a low percentage, for raising steam and for making coke and by-products. Anthracite and semianthracite burn with great heat and without much smoke and are, therefore, good for domestic fuel.

Reserves of coal. Owing to variations in heating quality, tonnage (Fig. 41) is not a complete criterion of coal reserves. The



"Minerals Yearbook," U. S. Bu. of Mines

Fig. 40. Relative rank of energy resources.

inferior classes are also located poorly for all but local markets. In the future it may be possible to make cheap power from them by converting them into electricity in large mechanized plants. But at present there is only a limited market for the electricity in those regions where the coal exists.

The total national reserve of all kinds of coal is about 3.4 trillion tons, roughly 50 per cent of the total reserve of the world. We have not used more than 1 per cent of the original quantity, but much of the remaining supply will not be available reasonably.

Major coal-producing areas. The coal provinces, separate fields, and mining centers are outlined in Figure 42. There are usually

several fields within each province, but mining is done in only a few districts in each field. The market for each bituminous field

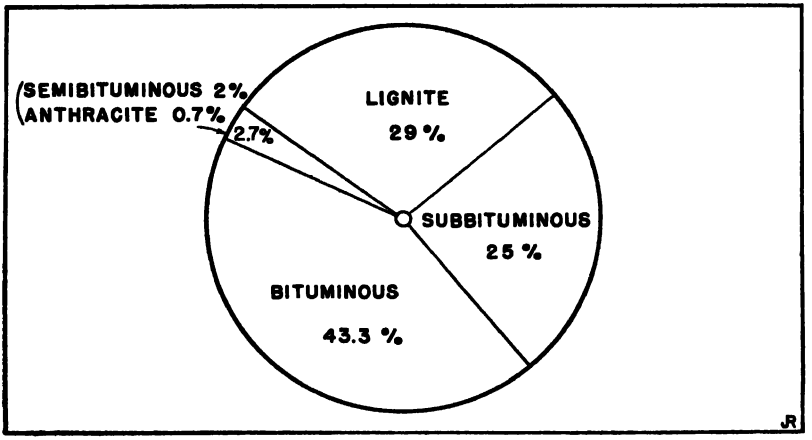


Fig. 41. Distribution of coal reserves of the United States among the different classes of coal

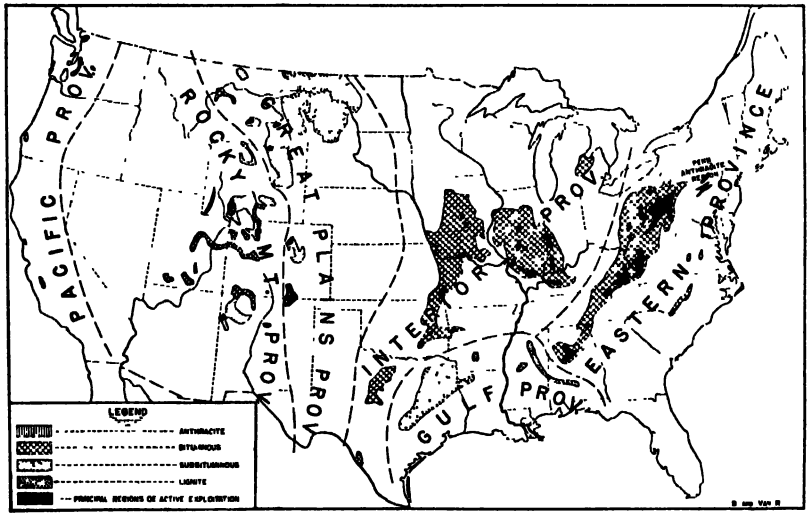


Fig. 42. Coal provinces of the United States.

is determined by the kind of coal and by the competition of other fields; the latter is determined by freight rates and other costs of production.

The Appalachian region, with abundant reserves of coal of good quality and with a central location in a region of good transportation facilities and a heavy demand, contributes 73 per cent of the national output of bituminous coal. There are three separate producing districts within it. The *southern* district, with 10 per cent of the output of this field, has its center at Birmingham. Iron and steel mills and railroads consume most of the output. The highest quality is from the Harlan section of Kentucky; it is marketed widely for domestic fuel and for the manufacture of coal by-products.

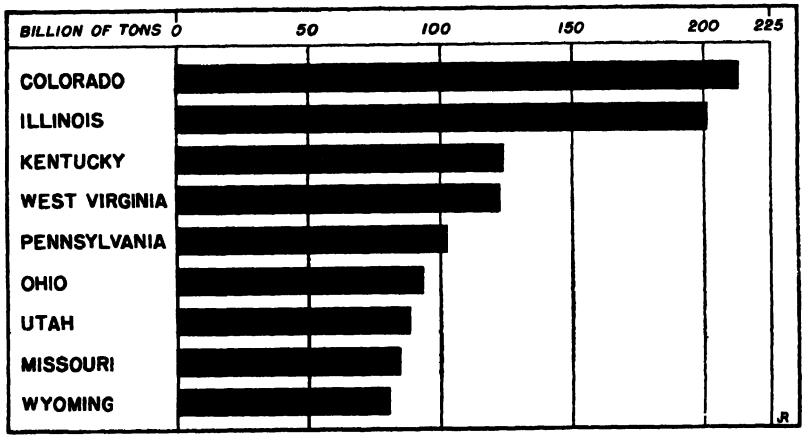


Fig. 43. Leading states in reserves of bituminous coal. (Figures from U. S. *Geological Survey*.)

The *middle* Appalachian district in southern West Virginia and adjacent parts of Virginia and Kentucky is now our leading coal-producing district. Since there are few manufacturing industries in this area, and since much of the coal is too friable and expensive for extensive use as a railway fuel, an outlet must be found elsewhere. However, the deposits are located favorably for shipping in both directions. Coal is sent to Norfolk, our leading coal-exporting point, for bunkering and for export, and to the Lake ports, where there is keen competition with the Pittsburgh district for the Lake markets. Coal, for both domestic and

manufacturing purposes, is also shipped from this area to the Piedmont section and the Ohio Valley.

The *Pittsburgh* district mines all types of bituminous coal and has the world's largest deposits of excellent coking and gas coal, the former occupying the Connelsville basin. In the western portion of the district the coal changes from a superior steam coal to one rich in gas.

There is a heavy demand for this coal from the manufacturing industries in the Pittsburgh district and from railways. Coal is shipped down the Ohio River, to the middle Atlantic seaboard,

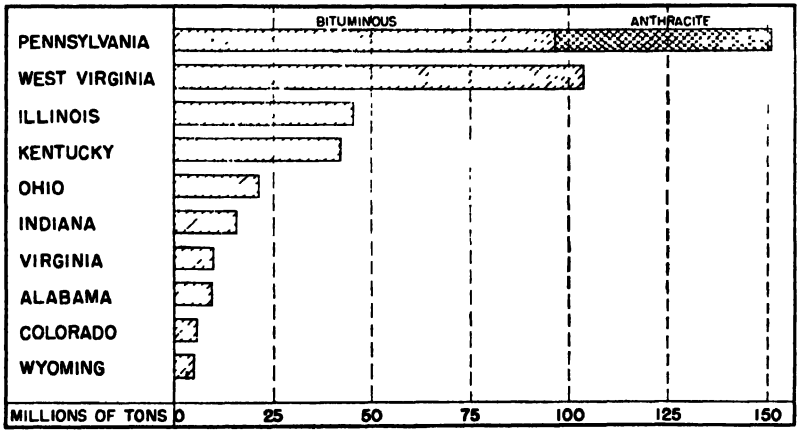


Fig. 44. Average annual production of coal of the leading states, 1934-36.

to the Lake ports to be used locally or to be sent to the Northwest and to Canada, and to New England by way of the Mohawk route.

A large portion of the coal mined here is from a seam known as the Pittsburgh seam, which merits a brief description on account of its world-wide fame.

The Pittsburgh coal seam underlies an area of about 50 square miles and originally contained about 10 billion tons of available coal. About six feet thick and of fairly uniform thickness, it is nearly horizontal over large areas, and therefore adapted for machine mining. The entire region has been deeply dissected by streams which, incidentally, center at Pittsburgh, exposing veins of

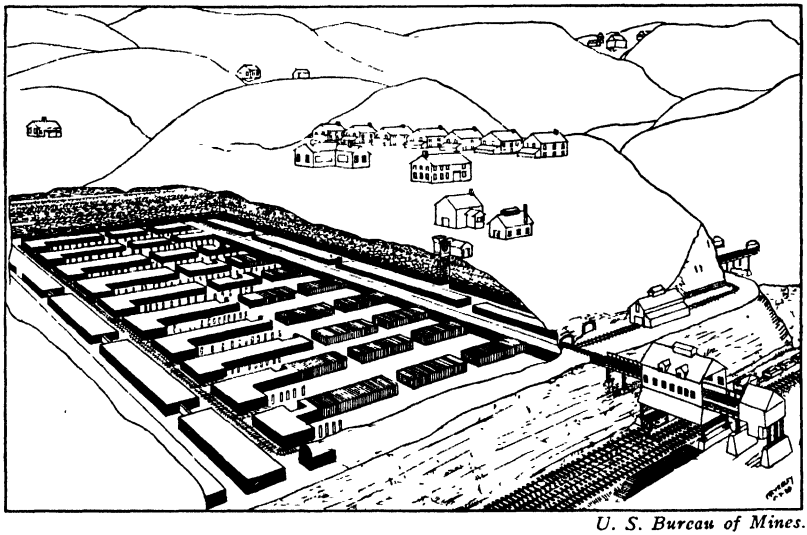
coal on the slopes of the valleys, some of them only slightly above the level of the valley floor. There is therefore but little deep mining, only about 20 per cent of the coal being mined by shaft methods. About 50 per cent is mined on the upslope, the loaded cars moving by gravity to the mouth of the mine, and 20 per cent on the downslope. The streams have also built terraces along their courses, which serve as sites for railroad tracks and miners' villages. Thus the geology of the coal seam and the physiography of the region have combined to make a great low-cost mining center.

The second-ranking coal field is in southern Illinois and adjacent parts of Kentucky and Indiana; this district supplies 18 per cent of the national output. St. Louis and near-by industrial centers, the Chicago area, and the railways of the region draw their supplies from this field, and coal is also shipped to the Northern States, where it competes with Lake coal.

The remaining mining centers produce small quantities, largely for use within the regions. Some coal from Colorado moves as far east as Iowa, however, and the intermountain fields of the West ship to the Pacific coast. Texas provides bunkering coal at her ports and exports small amounts to Mexico. In the plains, coal is important for domestic purposes and for railway fuel, and in the mountains of the West it finds a market in the various mining centers. Arkansas mines semianthracite, which is marketed for domestic purposes.

Anthracite coal is mined in eastern Pennsylvania, at Scranton and Wilkes-Barre. The market is stable because 60 per cent of the output is used for domestic fuel, largely in the Middle Atlantic and the New England States. Anthracite sells for a high price because of its superior quality for domestic and urban heating purposes. High prices are necessitated because the depth, folding, and faulting of the veins have made mining difficult and costly. The remaining supply is used largely for raising steam and power at the mines. There is a small production of anthracite in Gunnison County, Colorado, and other near-by places.

Methods of mining coal. Coal is mined by both open-pit and underground methods. Of the latter, there are two variations, the drift method and the shaft method. In open-pit mining (which is cheap where it is practicable), the coal is scooped up with steam shovels and loaded into cars. By the drift method tunnels are extended into the seams from the point at which these outcrop on slopes; by the other method shafts are sunk vertically from the surface. In the United States, the most

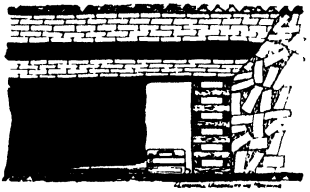


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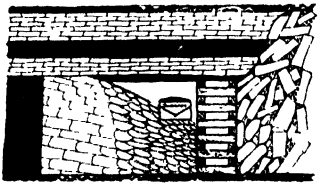
Fig. 45. Room-and-pillar method of mining Pittsburgh coal bed. Black faces represent coal. Note railway tracks both under and above ground.

usual size of shaft is 16 feet square and about 500 feet in depth, and consists of 4 compartments—2 for hoisting, 1 for ventilation, and 1 for such necessary appliances as electric wires and water pipes. Provision for ventilation is controlled carefully by law in most states, two shafts usually being required. Where both can be used, drift mining is usually more economical than shaft mining, but the latter makes it possible for seams to be worked at different levels. A complete mining plant consists of both underground and surface structures. Underground there are railways, ventilating equipment, a machine shop, and a room for the en-

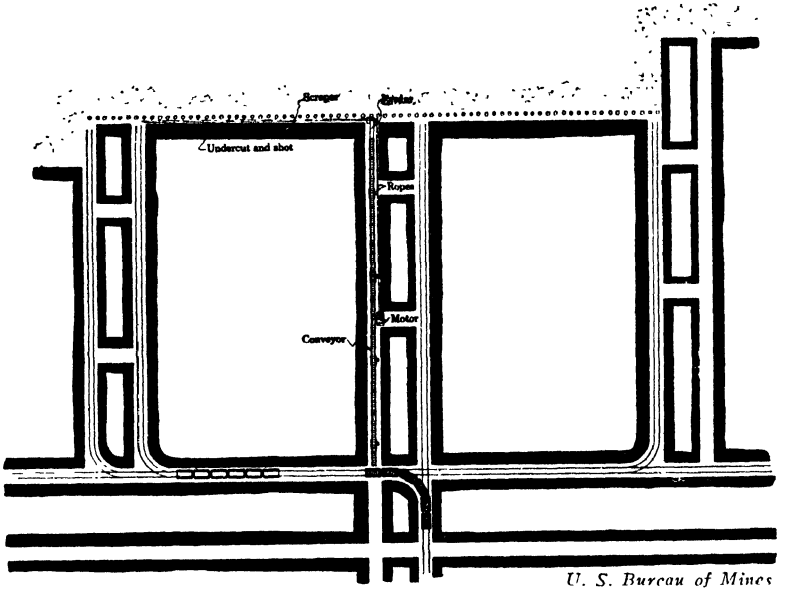
gines and other equipment and for storing supplies. On the surface are hoisting equipment and facilities for receiving the coal from the hoist cars and for preparing it for market, this being done in a structure called a "tipple" in the bituminous industry and a "breaker" in the anthracite.



Typical section showing cribs for supporting roof, also long-wall undercutting machine in operation



Typical section showing cribs for supporting roof, coal shot down and being loaded out by scoop.



U. S. Bureau of Mines

Fig. 46. Long-wall method of mining coal.

In underground mining, the coal is actually removed by either the room-and-pillar or the long-wall method. In the former, which utilizes a portion of the seam to support the roof, the layout is much like the streets of a city, tunnels being driven in every direction with large pillars of coal between them for supports (Fig.

45). After tunnels have been extended throughout the mine, the coal is gradually stripped from the pillars to the extent that safety will permit. By the long-wall method (Fig. 46) the coal is extracted along a continuous face and none is left to support the roof, props and pack-walls of stone and rubbish being used for that purpose. This method permits recovery as high as 95 per cent and is adapted to the mining of thin seams; the amount mined is governed by the necessity for preventing subsidence of the surface. By the room-and-pillar method usually about 50 per cent of a seam remains unused in the pillars. This method is the cheaper of the two and is the one most generally employed in the United States, where reserves of coal are plentiful.

Regardless of the method of removal, mining involves a certain sequence of steps. These are (1) loosening the coal from its bed, (2) loading and hauling to the shaft, (3) hoisting and dumping, and (4) preparing the coal for market. Coal is loosened from its bed by blasting or by undercutting, or by a combination of the two. Bituminous coal usually becomes too fine if blasted without undercutting. When only the latter is done, the weight of the mass and the pressure of the roof loosen the coal. Undercutting is done largely with power machinery. After being loosened, the coal is loaded into small railway cars either with large machines or by hand, after which it is hauled to the shaft with electric or gasoline locomotives. Hoisting is done by means of a stationary engine and a cable that winds on a drum. On reaching the surface the cars are run onto a platform, where the load is dumped into chutes. When dumped, the coal is weighed and the weight credited to the loader, who placed a ticket on the car when he finished loading. Preparation for market consists of removing the impurities and sorting the pieces of coal as to size, which is done chiefly by running the coal over shaking screens, the rock and slate being removed by hand. A considerable amount of coal also is washed by being run over a screen in a stream of water, to remove sulphur and other impurities not easily removable by hand. Underneath the screens the coal is caught in bins, from

which it is loaded into cars for shipment to market. When not screened, coal is called "run of the mine."

PETROLEUM

Nature and importance. Petroleum, or rock oil, is a mixture chiefly of the compounds of hydrogen and carbon. Like coal, it burns, and upon distillation separates into a number of products that are in such great demand that it does not pay to sell the crude product. Various of these refined products are used widely for light, power, and lubricants. Modern industry with its high-speed machinery would be impossible without large quantities of cheap lubricants, and thus far no satisfactory substitute has been found for petroleum as a lubricant. Among millions of people, kerosene lamps or paraffin candles are still the only form of artificial light. It is for generating power in automotive equipment, however, that petroleum is of most significance. So important is this use that petroleum has come to be of more international concern than any other mineral. Leadership on the sea and in the air now depends upon supplies of fuel oil and gasoline. The largest ocean passenger liners consume about 33,000 barrels of fuel oil in crossing the Atlantic. Consequently, all of the leading nations have been making strenuous efforts to obtain control of reserves of petroleum or to devise means for extracting motor fuel from coal, peat, and other products. To date, supplies of petroleum have been relatively cheap to obtain. Reserves are being exhausted rapidly, however, and in the not far distant future, although we may have

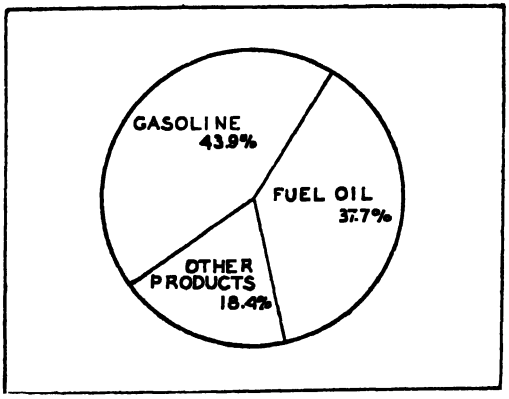


Fig. 47. Distribution of crude petroleum production of the United States among the principal refined products—average, 1934-36.

inexhaustible supplies from other sources, we may be compelled to make large capital investments in order to develop the means for the economical extraction of fuel from the present unused sources.

Occurrence. The general belief is that petroleum is of organic origin. Being a liquid, it must be trapped underground if man is to obtain it, and for this there are two requirements: (1) a basin or porous body of rock, this usually being sandstone, to

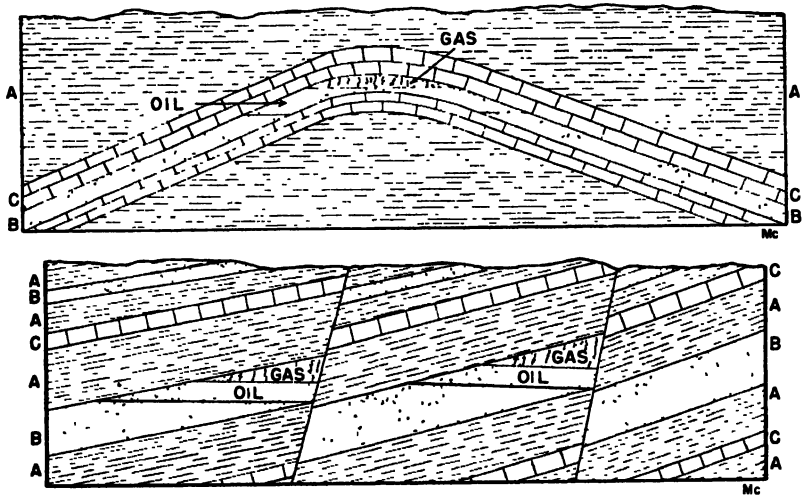


Fig. 48. Showing how oil is trapped underground by an anticline (above) and by a fault (below). A—shale, B—sandstone, C—limestone.

hold it, and (2) an impervious capping layer of clay or rock to prevent its escape. If the cap rock becomes cracked, as in an earthquake or through mountain-building processes, the petroleum is likely to escape. It is usually found, then, in regions where the rocks have been relatively undisturbed. All of the necessary conditions for the occurrence of petroleum are found on a larger scale in our southern plains region than probably anywhere else in the world.

Classes of petroleum. Petroleum varies in color, viscosity, weight, and chemical composition. The color varies from light brown to almost black. Some oils run freely, while others must be heated before they will flow. One classification used by the

industry is light oils and heavy oils; the former contain a higher proportion of the more valuable refined products and thus command a higher price. Another common classification is based upon the kind of residue which remains in distillation after the lighter elements have been removed. Accordingly, there are paraffin, asphalt, and mixed-base oils, the latter having a mixture of paraffin and asphalt. Paraffin oils contain a greater proportion of the lighter products, such as gasoline and lubricating oils; the asphalt oils, more of the heavy or less valuable products. Speaking generally, paraffin oils prevail east of the Mississippi, although there are some of equal quality in Oklahoma and Wyoming; asphalt oils occur along the Gulf; and all types occur in the mid-continent field.

The quality of crude petroleum is not so important as formerly, however, because recent chemical discoveries have made it possible to obtain almost any proportion of the products which are in greatest demand.

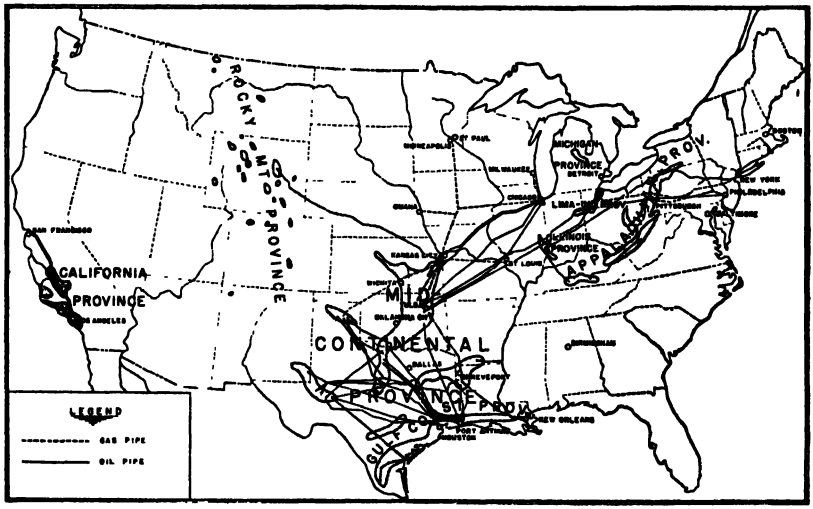
Reserves of petroleum. The reserves of petroleum are difficult to estimate because new fields are being discovered constantly and because of other, unexploited types of sources. The United States does not occupy so enviable a position with regard to reserves of petroleum, though we possess enormous quantities of oil shales, as it does to those of coal. However, the supplies of Latin America are accessible.

On January 1, 1939, the United States Geological Survey estimated the reserves of petroleum in the United States at about 17.3 billion barrels. This quantity has the power equivalent of the amount of coal of average quality that this country would use in about 15 years at the present rate of consumption (160 gallons of petroleum equal one ton of coal in fuel value). For transportation alone it will not last beyond a few decades.

Major petroleum-producing centers. The different petroleum provinces are shown in Figure 49. All of the provinces east of the Mississippi except the new one in Michigan and a recently discovered one in Illinois near St. Louis are approaching exhaustion,

and neither of the new ones gives any indication of a great output. In some places deeper wells and improved pumping have prolonged the life of the field. The combined output of all of the states east of the Mississippi is only 10 per cent of that of Texas. The Appalachian province is especially noted for the quality of its lubricating oil.

The midcontinent province is the world's greatest oil-producing



Renatson & Van Royen, "Fundamentals of Economic Geography."

Fig. 49. Map of the oil provinces and the principal pipe lines of the United States.

territory, supplying about 60 per cent of the domestic production. This area has been in production since 1906, but its boundaries are constantly being extended by exploration, and it is thought that maximum production has not yet been reached.

The fields along the Gulf coast produce about 10 per cent of the national output. The proportion of gasoline extracted from this oil is not high, but some types of crude oil are valuable for manufacturing lubricants. Much of the crude is sold for bunkering fuel.

There is a small output from scattered sources in the Rocky Mountain province, and further exploration may result in the discovery of other deposits.

In California, the deposits are in the southern end of the San Joaquin Valley around Bakersfield, and in basins along the coast, principally near Los Angeles. Heavy gas pressure accompanies these deposits, and the reserves of crude are thought to be large. In this area, because of the scarcity of coal, petroleum is important for railway fuel and for bunker fuels for ocean shipping. It is also used in generating electricity and for other purposes for which coal is commonly used in districts where it is plentiful.

Methods of production. In obtaining petroleum from under ground, three steps—drilling, pumping, and storage—are involved. Drilling for both experimental and production purposes must go

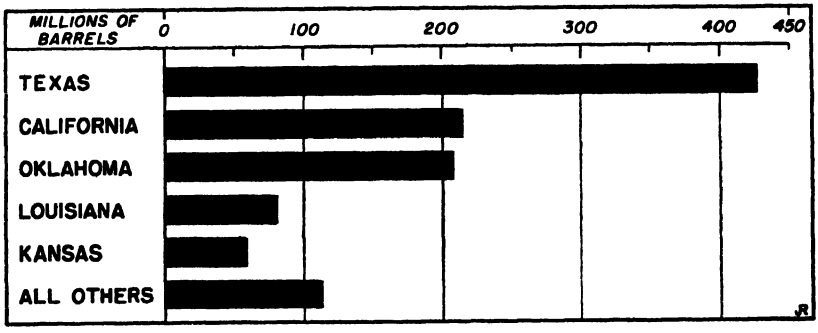


Fig. 50. Leading states in the production of crude petroleum in 1936.

on continually, and is expensive because of the depth of the wells and the number of dry holes. This number, formerly high, has now been reduced much by the development of the science of oil geology. This is important because drilling averages $20,000 or more a well for the shallower borings.

There are two methods of drilling—the standard, or cable-tool, and the auger, or rotary. By the former, which is used in hard formations, a string of heavy tools with a drill on the bottom is fastened to a cable and is dropped repeatedly, gradually forcing its way through the rock. With the auger method, which is used in soft formations, a bit is fastened to a heavy iron pipe which is turned continuously with machinery. A stream of water is forced

down through the pipe and flows back between the drill and the wall to carry out loosened material. As drilling proceeds, metal casing, its diameter decreasing downward, must be placed in the bore to prevent the sides caving in and to keep out ground water. When oil is struck, a charge of explosives is set off in the bottom of the well to make it flow more freely. The pressure of underground water or of natural gas is sufficient to make gushers of some wells and to cause others to produce without pumping for a time; but most wells must finally be pumped.

Petroleum is pumped through pipes into tanks or pools which are connected with the tanks of pipe-line systems, these leading to the large shipping and refining centers with their large tank farms. When production is heavy, storage near the field becomes necessary; otherwise the oil is sent directly to the next step, refining. Storage is expensive because of loss through evaporation and the fire hazard.

The refining of petroleum. In refining, petroleum is first distilled. The resulting products are refined and blended to suit the demands of the market. The number of refined products that may be made is almost unlimited. There are four methods of refining: ordinary refining, cracking, hydrogenation, and polymerization. The principles involved in each will be described briefly.

In distillation, or ordinary refining, heat is applied and as each constituent reaches a certain temperature, it vaporizes and passes off into a condenser. The lighter oils, such as naphtha and gasoline, vaporize at lower temperatures than the heavier, and thus pass off first.

We are learning, however, how to get more and more of the lighter oils out of the different types of petroleum. In 1912 chemists discovered the cracking process, which obtains twice as much gasoline as the older process. By this method, heavy distillates are kept for hours under high temperatures but are prevented by pressure from boiling and vaporizing. The constituents which

would naturally pass off as a vapor are retained, and under the high temperatures are broken up, or cracked, into the lighter gasoline. This breaking up of the molecules makes possible the abstraction of more gasoline from them.

The hydrogenation process, developed by Bergius in Germany to extract fuel oil from coal, is not used much at present in refining petroleum. Recovery of gasoline as high as 100 per cent is claimed for it. In this process, which also involves cracking, crude oil is heated under pressure in the presence of free hydrogen, the latter being absorbed chemically. This process converts the crude oil into a lighter type and increases the proportion of gasoline which it contains.

Through polymerization the refining industry of the United States is obtaining large quantities of superior gasoline at low cost from waste gases and low-grade products of the cracking processes. This type of gasoline may be used for blending purposes and is valuable for high-speed engines, especially in military aviation. In polymerization two or more molecules of the lighter constituents of petroleum are induced to combine to form a new molecule, which has a higher boiling point than the original ones; lighter products are converted into heavier products having a normal gasoline boiling range.

By whatever process of differential distillation they are derived, petroleum products contain some impurities which must be eliminated by various methods of chemical treatment before they are fit for consumers' use. Refining involves not merely differential distillation but also the chemical processes necessary to remove impurities.

Location of refineries. Most petroleum is refined near the market. Some of the leading centers indeed are near the producing fields, but there is usually a market near by. Refining is done near the market because the charge for transportation is less on the crude oil than on the more valuable refined products and because the more densely populated districts provide the markets for the various major products and by-products from refining. Many of

these products are of a somewhat complex nature, and there is keen competition among the different companies in marketing them. Such activities can be organized and supervised better in the marketing centers.

There are now about 700 refineries in the country. Texas has more than 80 and California about 50. These two states, with Pennsylvania, refine half of the output, with 25, 15, and 11 per cent, respectively. Other states which rank high are New Jersey, Oklahoma, Indiana, Louisiana, Ohio, and Illinois. In Texas, California, Oklahoma, and New Jersey, oil refining is now the leading manufacturing industry. Although Bayonne, New Jersey, is the leading center along the Atlantic coast, refining is done in every important seaport from Boston to Brunswick, Georgia.

These refineries handle both domestic and imported crude oil and are located well for exporting their products. Whiting, Indiana, which supplies the Chicago area, is a great center. Other interior centers in the East are Buffalo, Cleveland, and St. Louis. In the South, Baton Rouge is an important center, obtaining oil by pipe line from the midcontinent field and by boat from both domestic and foreign sources. Petroleum products are the leading item of traffic on the lower section of the Mississippi. The other centers are either near the oil fields or in near-by seaports which are connected with the fields by pipe line.

The petroleum-refining industry has an annual production of upward of $1\frac{1}{2}$ billion dollars, and is normally outranked only by the steel, automotive, meat-packing, and publishing industries. It employs only 69,000 men. An important feature is the small amount of labor required, the work being done largely with transportation equipment and machinery representing huge investments.

The transportation of petroleum. Being a liquid, petroleum requires special means for its transportation. Pipe lines, tank trucks, tank cars, and tank ships (tankers) have been devised for the purpose. There are about 136,000 miles of pipe lines, representing an investment of more than 1.1 billion dollars. They are

of such strategic importance in the conduct of the industry that they have been placed under the supervision of the Interstate Commerce Commission. Pipe lines are used principally to transport crude oil from the field to the refining centers, but they have recently been used in the Northeast to pipe gasoline from the refinery to the distributing center. It is cheaper to transport oil by pipe line than by rail, and pipe lines can be built in places where railways would not pay.

There are also 40,000 tank trucks and more than 150,000 tank cars for moving refined products, and almost 400 tankers which haul both crude and refined products. The railways haul about 1¼ million cars of petroleum products annually.

Foreign commerce in petroleum products. Because of the world-wide need of petroleum, abundant supplies of crude petroleum within its boundaries and an early start in the refining industry, the United States has an extensive foreign trade in the products of petroleum. For several years it has averaged about 11 per cent in value of the total exports and 2 per cent of the total imports. Refined products comprise 80 per cent of the exports, while the imports are chiefly crude oil. During the past decade our exports of refined products have suffered a marked decline, but those of crude oil have doubled. This is not only an indication of our heavy production of crude, but also of the rise of foreign refining centers and the growth of the domestic market. Among the exports, gasoline and lubricating oil have recently been of about equal importance, but there is a considerable export of fuel oil, much of it as bunkering fuel at our seaports.

Canada, with 15 per cent of the exports, chiefly of crude oil, is our best customer. The United Kingdom, taking mainly refined products, is second, followed by Japan and France, which purchase chiefly crude oil; the German Reich, importing chiefly lubricating oil, is next, followed by Italy and Australia.

Imports are nearly all from the Caribbean region, particularly Venezuela. For several years imports of petroleum have been declining.

OIL SHALES

Oil shale, of which there are whole mountains in Colorado, Wyoming, and Utah, is a stratified sedimentary rock containing only a small percentage of petroleum. At present the cost of extracting the petroleum is so high that the oil cannot compete with the more easily obtained supplies. Better methods for mining and treating the shales must be developed, as well as methods of treating the oils of particular shales, because not all shales are alike. Extraction of the oil from the shales requires the investment of large sums in plant and equipment. Gas and ammonia gas, which can be turned into nitrate, are by-products of the industry. Since the shale must be treated near its source, which is far from the markets for petroleum products, there is the added problem of transporting the finished products.

NATURAL GAS

Occurrence. Natural gas originates and accumulates under ground in the same manner as petroleum. It occurs in most petroleum fields, in some places with coal, and often it is found alone. The great petroleum fields are the leading centers of production. Because these fields are not usually near great markets for the gas, a great amount has been permitted to escape into the air. Natural gas has an important function in the production of petroleum, furnishing, as it does in many cases, the pressure which aids in bringing the oil to the surface. When the gas is permitted to escape, the pumping of the oil wells becomes more expensive. In some petroleum fields the gas is used to repressure oil wells in order to increase the recovery of the oil.

Uses. The use of natural gas has increased rapidly in recent years, the consumption in 1937 being more than 2.9 times that of 1920. It is now about equal to water power as a contributor of energy (Fig. 40). This growth in consumption has resulted from the discovery of several new petroleum fields, the realization by public-utility operators that it was a valuable supplement to their

other energy resources, the development of improved types of pipe and better machinery for laying pipe, and the extension of long-distance pipe lines to new markets.

Natural gas is used for both industrial and domestic purposes, 80 per cent being for the former. It is desirable as an industrial fuel because of the accurate control which it gives over temperatures and because of the lack of contained impurities, both features being important in the manufacture of such products as glass,

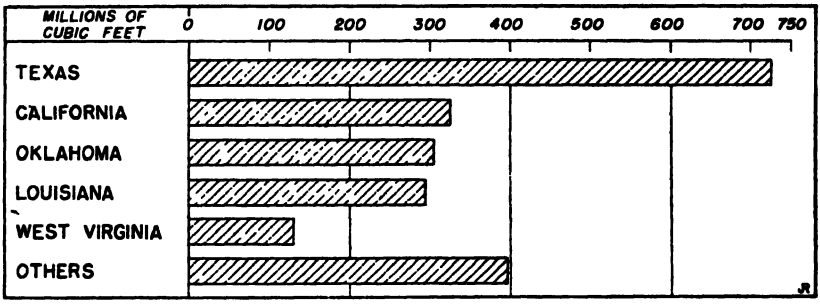


Fig. 51. Leading states in the production of marketable natural gas in 1936.

ceramics ware, and alloy steels. It is also easy to handle and does not require storage like other fuels. Cleanliness, convenience, and cheapness make it desirable for domestic fuel.

About one third of the industrial use is in the gas fields in connection with the operations for producing the gas. It is also used for the refining of petroleum and the production of sulphur and alkali in the Southwest. At the field it is very cheap, the price in 1937 being 5 cents per cubic foot compared with an average price of 72.3 cents for domestic purposes. The manufacture of carbon black is second among the industrial uses, requiring about 16 per cent of the total. Eighty per cent of the carbon black is sold to rubber manufacturers, who employ it as a coloring agent. Electric utilities consume about 8 per cent of the amount used for industrial purposes. Other industries which use it, in addition to the glass, ceramics, and metallurgical, are cement and brick plants, some food-manufacturing industries and plants making building materials that require heat treatment.

Natural gas contains a few by-products. Helium, a noninflammable substitute for hydrogen used in lighter-than-air craft, is often an impurity of natural gas. It may also contain gasoline so light that it must be mixed with other crude-oil products before it will serve as motor fuel. Roughly, one gallon is obtained from every thousand cubic feet, and practically the entire production is treated to recover the gasoline. The extraction of the gasoline

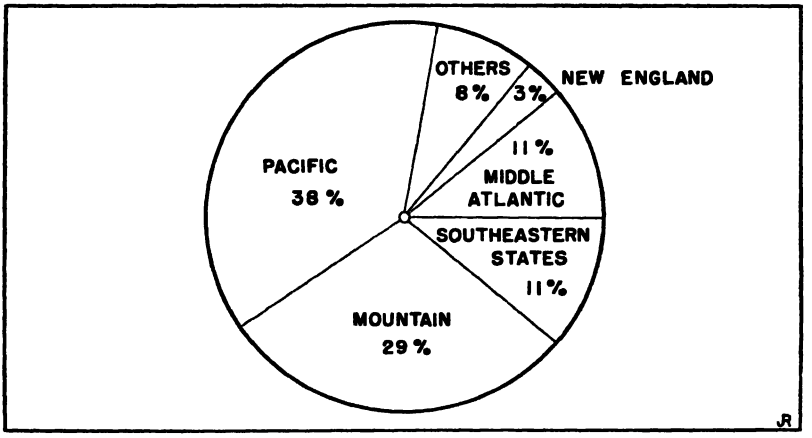


Fig. 52. Regional distribution of potential water power of the United States (Figures from *U. S. Geological Survey.*)

also enables the natural gas to flow through the pipe lines more easily.

Reserves. According to conservative estimates, the reserves will not last more than a few decades, but so long as new petroleum fields are discovered, new supplies of natural gas will probably be found. These new discoveries are likely to occur at increasing distances from centers of population, necessitating longer pipe lines and a higher cost for fuel.

WATER POWER

Requirements for water power. Rugged topography, in conjunction with heavy, constant rainfall, creates the best conditions for abundant water-power resources. This ideal is not approached except in the highlands of equatorial Africa, which contain almost

half of the world's potential water-power energy. Glaciated regions also have abundant water power, being usually rough and having lakes and often glaciers and snowfields which provide natural storage.

Water can develop power by its weight, pressure, or velocity, or by a combination of velocity and pressure. In an overshot wheel, weight is employed; in an impulse wheel, velocity develops the power.[3]

Water-power regions. The regional distribution of developed

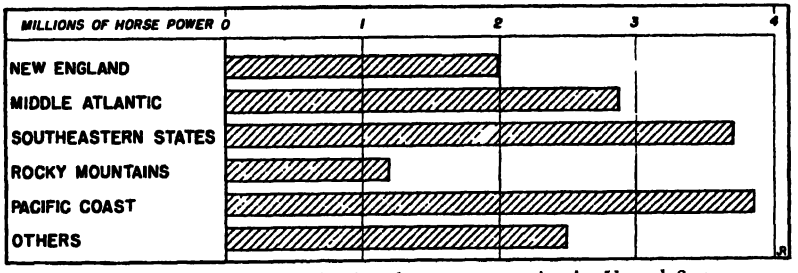


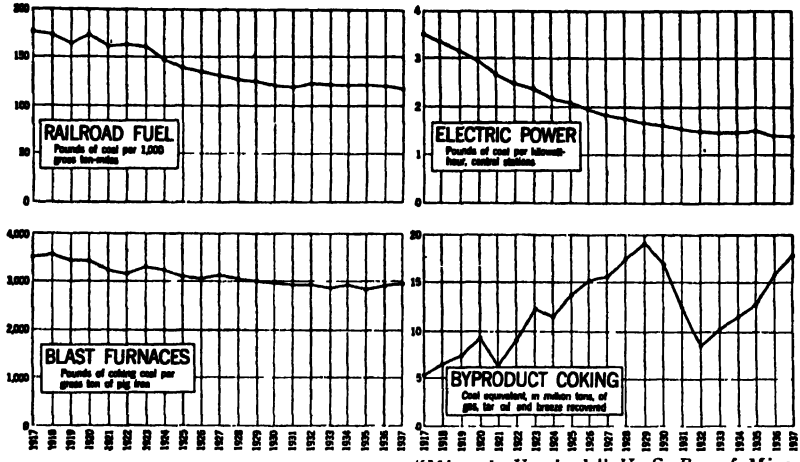
Fig. 53. Regional distribution of developed water power in the United States in 1936. (Figures from *U. S. Geological Survey.*)

and potential water power in the United States is shown in Figures 52 and 53. It has been estimated that there are 35,000,000 horsepower easily available 90 per cent of the time, and 55,000,000 horsepower for 50 per cent, and that the development of all of the sites might result in as much as 200,000,000 horsepower. Much of the potential power is in regions that are almost devoid of coal, a fact of significance, because some of these regions are otherwise adapted for manufacturing. The Pacific States have a relatively small population, and manufactures requiring large amounts of power do not develop rapidly. Hydroelectric energy is much used there for transportation. In New England almost all of the potential power has been developed. The further discussion of water power is deferred until Chapter 22.

[3] In falling water, horsepower is the product of the number of pounds falling per second and the distance of the fall (head). One horsepower is 550 foot pounds per second.

EFFICIENT UTILIZATION OF POWER RESOURCES

Coal. Coal cannot possibly be replaced by other existing commercial sources of energy. It is important then that it be produced and consumed by the most efficient methods. It is not the lack of coal under ground that creates a problem, but rather an increasing price resulting from the exhaustion of the better and more available supplies. Relief will result from better methods of mining and from improved machines and methods for turning the coal



"Minerals Yearbook," U. S. Bu. of Mines.

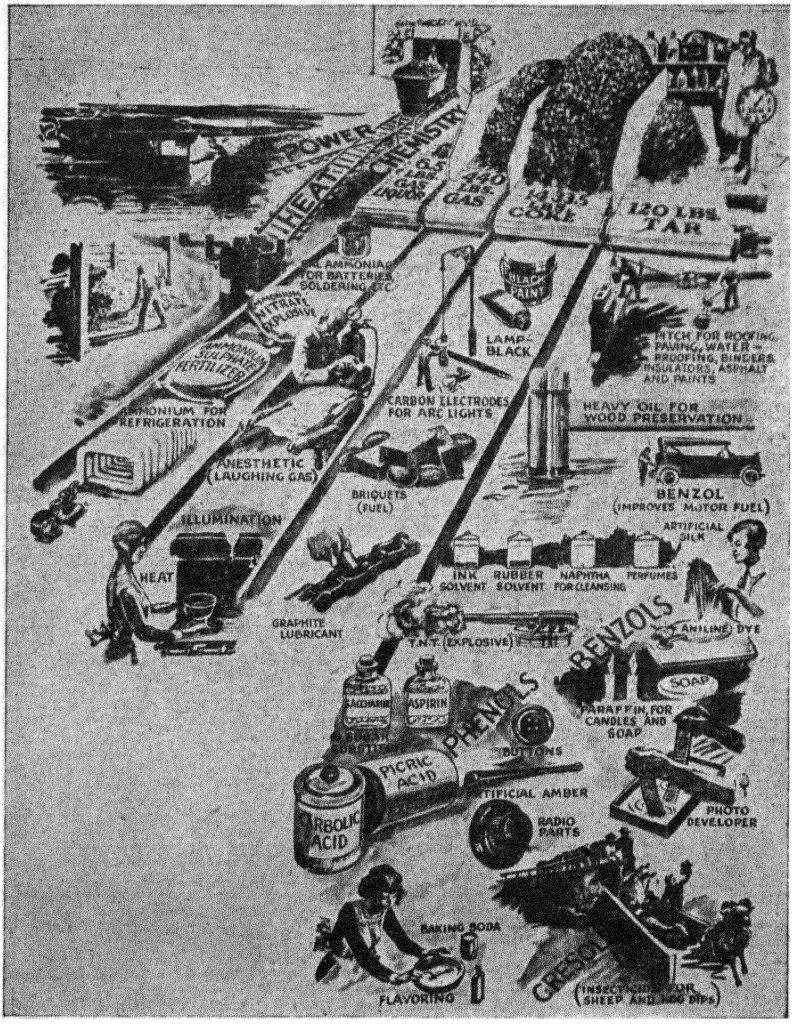
Fig. 54. Declining use of coal.

into energy. From 30 to 40 per cent of the bituminous coal is wasted in the mining, and the average steam equipment gets less than 20 per cent of the potential energy out of coal. There has been, moreover, unnecessary expansion and competition in the mining industry.

Since the World War marked progress has been shown in the efficiency with which coal is consumed. Per capita consumption is about 3 tons at present, compared with 4.4 tons in 1911. Much of this gain is due to improvements in the steam turbine, but boilers and methods of stoking have also been improved. Gains of

this sort are the equivalent of increasing the reserves of coal. Further savings may result from turning coal into electricity or gas or liquid by the hydrogenation process near the mine and by treating it to obtain all of the by-products (Fig. 55).

A German authority has said that the nation that leads the world in the future will be the one that makes the most efficient use of its coal resources. In the United States only about 20 per cent of



Popular Science Monthly.

Fig. 55. Coal by-products.

our coal is utilized in a manner to save all of the by-products. These products have not been saved because it has not been profitable for industrial concerns to save them; expensive processes and machinery are necessary, and existing products would compete for markets with these by-products. It has also been difficult for us to compete with Germany in their production. Furthermore, demand is limited for many of the by-products, while the quantity which might be produced is so great as to reduce the market price below the cost of production. The industries in which coal is used have been so profitable that their owners could afford to use the coal only for fuel.

Petroleum. The problems relating to the utilization of petroleum are similar to those for coal. There has been immense waste because of unrestricted drilling, unnecessary competition, laws regarding the ownership of oil underneath the land, and the methods of storing. While the average internal-combustion motor has about double the efficiency of the average steam equipment, the most efficient internal-combustion motors are not much more efficient than the best steam equipment. Engineers are working continually to make better motors and better types of gasoline. Recently, both legislation and voluntary coöperation have helped solve some of the problems resulting from competition. There has also been progress in devising methods for obtaining from the crude oil a greater percentage of the elements more in demand, and for utilizing the by-products more completely. In 1914, only 18 per cent of the crude oil was made into gasoline; in 1937, the percentage was 44. By the cracking and hydrogenation processes it is possible to obtain more than 60 per cent.

While there may be a shortage of petroleum in the future, the world need not fear a shortage of motor fuel, because alcohol, obtained from vegetation, may be used. A few factories are manufacturing this type of fuel now and selling it to be mixed with gasoline. According to various experiments, the mixture costs more than gasoline alone but is superior to gasoline as a motor fuel. With regard to lubricating oil the picture is not so bright. No sat-

isfactory substitute has been found, and our high-speed machinery requires large quantities.

Natural gas. The nation has been most wasteful with its natural gas, permitting a large part of the original supply to escape unused into the air. During the first 7 months of 1935, one billion cubic feet per day escaped from the Panhandle field in Texas. During that year the state enacted legislation prohibiting waste in the production and use of natural gas, and within a year the escape had been reduced almost 50 per cent.[4] The greatest waste recently has been through operators' wasting the gas by extracting solely the natural gasoline which it contains. A growing practice is to return the gas underground for storage; more than 11 billion cubic feet were saved in 1935 in this manner.

Except in the regions of production, where it is a cheap fuel, natural gas should probably be reserved as much as possible for domestic fuel. However, it contains by-products and is becoming an important basic material in the manufacture of chemicals.

Water power. The efficient utilization of water power takes the form of controlling its development. It should be made into a permanent asset in a way that will result in the distribution of electricity to the greatest number of consumers at the most economical price. An important problem is to protect the public against monopoly.

Many persons seem to believe that water power is a permanent and inexhaustible asset, which it can hardly be, unless it is carefully developed. The proper type of program for development is a comprehensive one. Water power cannot be considered a free asset, because immense capital expenditures are required to develop it. Expensive equipment is necessary, long transmission lines must be built, valuable lands must often be purchased for reservoir sites. Since much of the cost is fixed, or overhead, expenses continue whether the plant is being operated or not.

The influences controlling the permanency of water power were discussed in Chapter 2, but they will bear repeating briefly. Un-

[4] *Minerals Yearbook*, 1936, p. 741.

less provision is made to prevent reservoirs filling with silt, they may gradually fill and become useless for water-power purposes. And to obtain the greatest efficiency, reforestation to give a uniform stream flow should be inaugurated. As forests are cut, stream flow will become more erratic, making it impossible to keep the original plant operating constantly. Dams may be built, but they are expensive.

A mistaken idea exists that water which goes over a falls unused is a natural resource that has been forever lost. True, it can never be used, but this does not indicate that a loss has been incurred. There has been a loss only if its use would have resulted in greater economy than the use of some other resource to give an equal amount of power. There would have been a loss if using it were more expensive than using other sources of energy. The cost of production in industries which might have used it would have been greater, and their products or services would have cost the consumer more.

7
FISHERIES

Importance. In the past, fisheries have had far-reaching political effects throughout the civilized world. They have also supplied large quantities of food, and their significance in this respect will probably increase if denser populations cause meat production to become less profitable than it now is. Politically, fisheries have led to exploration and discovery (those of the North Atlantic led Europeans to North America); they have been a training ground for seamen to man the merchant marines and navies of the world; and they have caused quarrels between countries which had to be adjusted by treaty or otherwise.

Neither the number of people engaged in fishing nor the value of the product is important when compared with corresponding figures for most other industries. Japan leads the world in the value of its fishery products, with about $175,000,000 annually. The United States and the United Kingdom have about $110,000,000 each, and Canada and Spain each about $65,000,000. The annual per capita value is about $2 for both Japan and the United Kingdom. The latter, however, exports almost half of its catch, while that of the Japanese is used largely at home. The sea contains untold possibilities, but development will probably take place only gradually. Although the products of fisheries are much less valuable than those of the other extractive industries, it must be remembered that they are highly important to the welfare of many local groups.

The United States Bureau of Fisheries states that few foods can furnish the quality and variety of nutritional factors provided by fishery products. They are an excellent source of highly di-

gestible protein, are rich in vitamins, contain an abundance of various minerals, and some have a high fat content.

Fish, however, are not consumed widely in the United States. The greater part of the catch is used within a few hundred miles of the seacoast. The per capita consumption is only 13 pounds annually, compared with 40 pounds in Great Britain. As one means of encouraging greater use, the Federal Government maintains a cooking school at Washington to conduct research into methods of preparing fish. Recently, better-organized methods of fishing and marketing, better methods of preserving, and faster transportation have encouraged a somewhat greater consumption.

Location of fisheries. Most of the important fisheries are located on banks or shallow places in the ocean, where the fish congregate to feed or spawn. Food is abundant because the shallow waters permit solar energy to reach sea bottom and thus produce an abundant aquatic flora, which furnishes the basic food supply for fish. Most fisheries are in water under 600 feet in depth. In deeper water are fewer fish, and, consequently, fishing becomes more expensive. There are four important fishing grounds: in the North Sea and adjacent waters, in the North Atlantic off the eastern coast of North America, along the coast of northwestern North America, and along the coast of northeastern Asia in the region of Japan. All of these grounds are in the cool temperate latitudes. Because of the glaciation and other forces, these latitudes in the Northern Hemisphere have broad, shallow continental shelves which provide excellent feeding and spawning grounds. Plankton, the minute particles of plant and animal life which maintain the life of the sea, is most abundant in cool waters and is most plentiful in the North Atlantic. It exists there in greatest abundance after the winter winds, ocean currents, and changes in temperature have brought water bearing nitrogen and phosphorus up from the depths, and when the lengthening days increase the amount of sunshine. The plankton has its source in inorganic materials that are changed through the absorption of the energy received from the sun by the water. It has been estimated that

300 tons of plankton are required to provide a single meal for the herring that are landed on the east coast of England in one year.

There are other reasons for the importance of fisheries in the cool, north-temperate latitudes. One of the most important is the fact that it is less expensive to preserve the fish here than in warmer regions. Although some of the best-flavored species are caught in tropical waters, on the whole, those of the cooler waters are superior for food because their flesh is firmer. Since several of the species travel in schools, fishermen find a greater return per unit of effort expended than if each fish had to be sought. Fishing is also encouraged in northern latitudes by the lack of other economic opportunities in some lands adjacent to the great fishing grounds and by the favorable location of the fishing grounds for marketing fish.

Types of ocean fisheries. There are two types of ocean fisheries: (1) offshore and (2) shore and shellfish. The important offshore species are the cod, halibut, haddock, tuna, tile, and sea bass. Important shore species are the salmon, herring, whiting, mackerel, flounder, bluefish, butterfish, and menhaden; the shrimp, oyster, lobster, and clam are the leading shellfish.

The control of ocean fisheries. Although each nation has control over the ocean fisheries within one league of its shores, the important fisheries are on the high seas and are not subject to any control, except to the extent that different nations have entered into agreements concerning them, as, for example, the restrictions on the killing of fur seals and whales. In the United States, there is no federal jurisdiction except in Alaska. Each state supervises the industry in its coastal waters and on its inland streams and lakes.

Fisheries of the United States. The table on the following page shows the regional division of the fisheries of the United States and Alaska, and the relative importance of each region with respect to the quantity caught and the value of the catch to the fishermen. The figures are for 1936, unless otherwise stated.

Region	*Quantity (Pounds)*	*Value*
Pacific coast	1,925,343,000	$24,882,000
New England[a]	655,530,000	17,984,000
Alaska	932,341,000	14,225,000
South Atlantic States	369,983,000	5,507,000
Gulf States	187,009,000	8,035,000
Chesapeake Bay	314,095,000	6,488,000
Middle Atlantic States[a]	279,438,000	6,416,000
Lake States[a]	94,277,000	6,389,000
Mississippi River and Tributaries[b]	82,383,000	2,897,000
Total	4,840,299,000	$92,823,000

[a] 1935.
[b] 1931

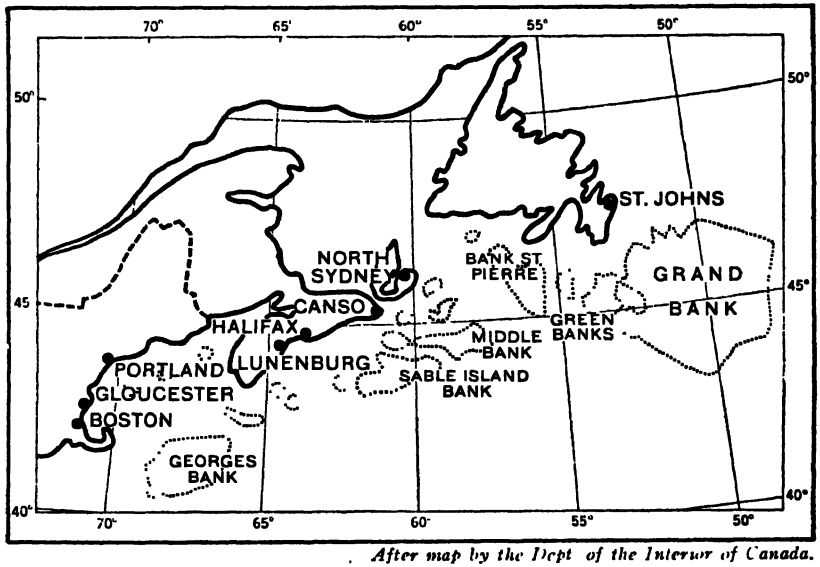
The line of division between the North Atlantic and the South Atlantic fisheries is about the latitude of Cape Hatteras. In the ocean off this point, a cold current comes between the Gulf Stream and the coast, making Cape Hatteras the limit for many of the species of both areas.

The fishing grounds of New England extend from the coast of Massachusetts to the Grand Bank, and are the world's greatest fishing grounds and the leading cod area. The Grand Bank, as large as all the other banks combined, has an area equal to that of Indiana, with a depth of not more than 360 feet. Green Banks is one of the best halibut grounds in the world, and the Gulf of Maine is the most important mackerel ground. The leading fishing ports in New England are Gloucester, Boston, and Portland. Boston is outranked as a wholesale fish market in this country only by the Fulton Fish Market in New York City. Haddock comprises about 40 per cent of the total quantity caught by New England fishermen, cod about 30 per cent, and mackerel 10 per cent. Haddock has become more important since the rise of the demand for filleted fish. The lobster is important along the coast of Maine.[1]

The Middle Atlantic region is important chiefly for the oyster industry, which employs more people than any other single fishery. The oyster ranks eighth in quantity, but second in value,

[1] For an excellent discussion of the Atlantic and Gulf fisheries see J. H. Matthews, "Fisheries of the North Atlantic," *Economic Geography*, 3:1-22, and "Fisheries of South Atlantic and Gulf States," *Economic Geography*, 4:323-348.

among the different species caught by the fishermen of this country. Chesapeake Bay and Long Island Sound are the chief oyster centers. The industry is aided by the recognition by the laws of the states of private property rights in oyster beds. Baltimore and Philadelphia are important wholesale fish markets for this area. The seasonal migration of fish is an influence in this region. For example, mackerel are caught from Cape Hatteras to the Gulf of St. Lawrence, depending on the season, which begins at Cape Hat-



After map by the Dept of the Interior of Canada.

Fig. 56. Fishing banks and principal fishing ports of northeastern North America.

teras about the first of April. New England fishermen come there and fish until the end of May, when they leave for the banks.

There are several fishing centers along the South Atlantic coast. One of the most interesting areas is the coast of North Carolina, where the great amount of water in sounds and inlets and the meeting of the warm and cold currents produce much variety. Albemarle Sound is the largest coastal body of fresh water in the world. It is important for shad and striped bass. Fish are more abundant in the inlets than along the shore. The leading species of the South Atlantic coast are bluefish, menhaden, croakers,

drums, mullets, and Spanish mackerel. The menhaden is not a food fish, because of its oily taste and boniness; but it is caught along the entire Atlantic and Gulf coasts for oil, fertilizer, and fish meal. Charleston and Savannah are important centers, the most extensive offshore fisheries of this region being off the coasts of South Carolina and Georgia. Beaufort, North Carolina, is the center of the only important scallop fishing in the South. Fernandina is the leading center of the east coast of Florida. The Indian River section of the coast is a center for turtles, which are marketed chiefly in New York City and Philadelphia.

The Gulf region, however, is of growing importance. Better methods of refrigeration, and the nearness to Gulf and Midwest markets are influences in this growth. The leading species are trout, sheepshead, channel bass, and red snapper. Mullet, shrimps, clams, lobsters, oysters, and several others are also important. There are 3,000 square miles of sponge-fishing grounds south and west of Florida. The largest bed of hard clams in the United States is near the Ten Thousand Islands. There are great possibilities, which are being realized, for oyster growing all along the coast. It is now an important industry in Texas. Southern oysters are marketed largely as canned oysters.

On the Pacific coast the pilchard, which is used for sardines, leads in quantity taken, but salmon provide 60 per cent or more of the total value of fishery products. Tuna, halibut, and herring follow salmon in value. The center of halibut fishing is Seattle. Salmon fishing extends from the Columbia River to the Yukon, Alaska supplying 80 per cent of the total salmon catch.

Fishing for tuna has recently grown into an important industry. Along our shores, the industry is most important between the California mainland and Santa Catalina Island. Ocean fleets, however, go as far as Hawaii and the equator, in fishing for tuna. The greater part of the catch is from the waters off the Latin-American countries. The center for this industry, and by far the leading center for fishery products in the Pacific Coast States, is Los Angeles, where there has recently been rapid expansion be-

cause of the building of canneries. There is an investment of $15,000,000 in canneries and boats and equipment, and employment is furnished for about 5,000 workers, most of them of foreign descent. The tonnage of fish landed at Los Angeles is now 50 per cent greater than that landed at Boston, but the catch at Boston is more than twice as valuable as that at Los Angeles. Tonnage

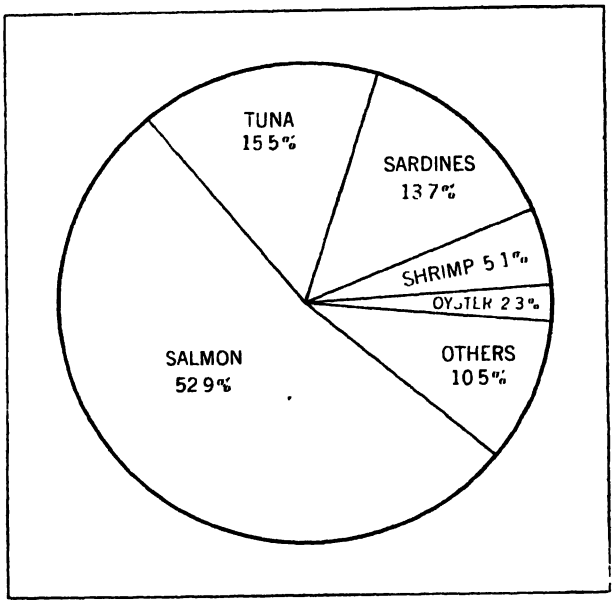


Fig. 57 Relative importance of the different canned fish in the United States and Alaska in 1936, in value

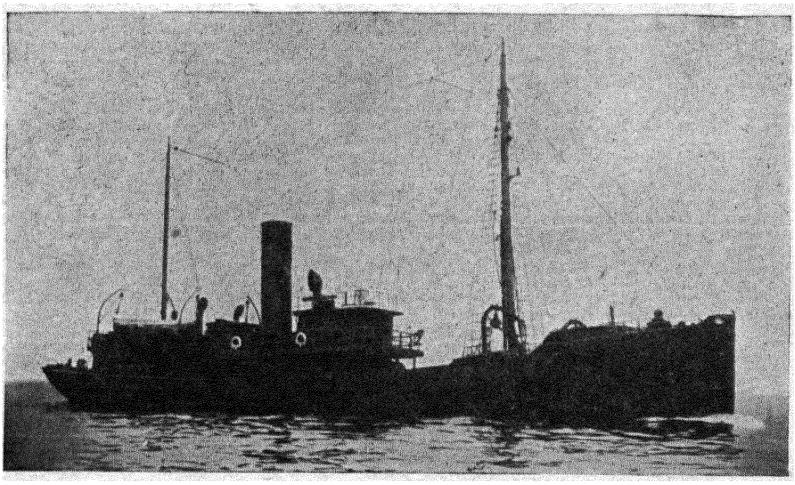
at Los Angeles is largely of sardines, fish of low value caught chiefly for their oil, which is used in manufacturing paints.

A large part of the fishery products of the Pacific coast is canned. Alaska stands first, with about 25 per cent of the total value of canned fishery products for the nation. California is next with 20 per cent, and then Washington with about 7 per cent. Salmon comprises about 50 per cent of the weight of canned fishery products, sardines 25 per cent, tuna 10 per cent, mackerel 5 per cent, and shrimp and clams each about 3 per cent.

The leading species caught on the Great Lakes are the lake

herring, whitefish, cisco, and lake trout; from the rivers and streams are clams, catfish, bass, carp, trout, and pickerel. Overfishing has resulted in a gradual decline in the importance of river fisheries.

Methods of the fishing industry. Modern methods have recently entered the fishing industry, but they have not been applied



Atlantic Coast Fisheries Corp.

Fig. 58. Steam trawler used in fisheries in North Atlantic.

extensively. Both the catching and marketing are being organized and coördinated. Most fish, however, are still prepared for market in the old manner. In this country cod and haddock are chiefly dry salted. Herring and mackerel are the leading dried and smoked species. Fat and oily fish are usually pickled in brine. Most of the salmon are canned in modern canning plants, where most of the work is done with mechanical equipment. Improved methods of refrigeration and faster transportation have resulted in the marketing fresh of a greater quantity. Several inland centers now receive regular supplies of fresh fish by airplane.

On the ocean, larger vessels and better equipment are being employed. Steam trawlers, which drag a large otter trawl (a bag-shaped, open-mouth net) behind them, are supplanting the older

methods of catching the fish and, according to some authorities, will in time drive some of the other methods out of existence. The different types of equipment for catching fish include the otter trawl already mentioned, purse seines, gill nets, lines, traps, wheels, and dredges. While the particular method used depends somewhat upon the manner in which the industry is organized, it depends more upon the habits of the various species. Some feed



Atlantic Coast Fisheries Corp. Photo by W. A. Ellison, Jr.

Fig. 59. Men throwing net overboard; fish on deck are almost exclusively cod.

near the bottom, others near the surface. Some run in schools, while others do not. Some may be caught in a different manner at one season than at another. The otter trawl, for example, is good for catching those which feed on the bottom, such as cod. Herring and mackerel are taken largely with gill nets. Mackerel are also caught with purse seines, usually at night. Cod and halibut are caught with lines. Cod is wary of a net except at spawning time, when it may be caught in that manner. Salmon are caught in traps, by wheels, and by various types of nets. A dredge (a rake-like implement) is used to scrape oysters loose

from the bottom of the sea. The size and financial support of the undertaking would also influence the methods used. Large vessels and otter trawls could not be used by fisheries of small financial resources.

The fur seal. The history of the fur-seal industry on the Pribilof Islands is a classic example of the results of the ruthless exploitation of a limited natural resource. By 1910 the number had been reduced to only one eighth of what it had been when Alaska was purchased. The seals live in the ocean for most of the year but migrate to these islands for about two months to mate and to give birth to the young. Hunting was originally done by those who followed the herds in the open ocean, by those who were granted the privilege of going on the islands, and by those who lay in wait on ships outside the three-mile limit. These last shot the mother seals as they swam in search of food for their young; and on the average five out of every six that were shot sank to the bottom of the ocean. Finally, in 1911, the United States signed a treaty with Great Britain, Russia, and Japan, whereby it agreed to divide the proceeds if these countries would aid in preventing the ruthless slaughter of the seals. The United States does the killing of a certain number of young males each year, and retains 70 per cent of the furs and gives Canada and Japan each 15 per cent. There are also small rookeries on the Commander Islands and on Robben Island. Under the treaty Russia agreed to give Canada and Japan each 15 per cent of the furs obtained on the Commander Islands and Japan agreed to give Russia, Canada, and the United States each 10 per cent of those taken on Robben Island. The herd on the Pribilof Islands now numbers more than 1.8 million.

8

THE CEREALS

WE turn now from the exploitive type of extractive industry to the productive or genetic type, that is, the type which attempts to replace the natural resources which are used up in the productive processes. Since soil is the most basic natural resource, plants growing from the soil and animals living on the plants—both supplying necessary products to man—it seems logical to discuss first the production of the staple crops, industries of the genetic type, which depend directly upon the soil. Of these crops, cereals comprise the major group and are, therefore, discussed first.

Cereals are used as food for man and as feed for animals, the use to which each one is put depending upon the standard of living of the region where it is grown and upon the degree to which several of the crops can be grown in the same region. They have food value because of the starch which they supply for body fuel, the protein, fat, and ash for nutrition, the germ for vitamins, and the husk or bran for bulk. Their average fuel value is about 1,600 calories per pound. Cereals consumed directly supply about 16 per cent of the normal food requirements of the American people, and almost 60 per cent of the food supply is furnished by animal products which depend largely upon cereals.

In this chapter are included corn and the so-called small grains, wheat, oats, barley, rye, and buckwheat. Corn is discussed first because it is the premier American crop and the backbone of the nation's agriculture. Wheat is next because it is our chief food cereal and the only one which is important in export trade. The remaining ones, oats, barley, rye, and buckwheat, are taken in the order of the value of the crops and the acreage occupied. Unless

one wishes to include liquors as a food, none of these grains is important in our diet, and except for buckwheat, whose production is negligible, not a large proportion of the total supply of any is used for human consumption.

CORN

Importance. Corn is the only important cereal that is native to America. The colonists were fortunate in finding a native prod-

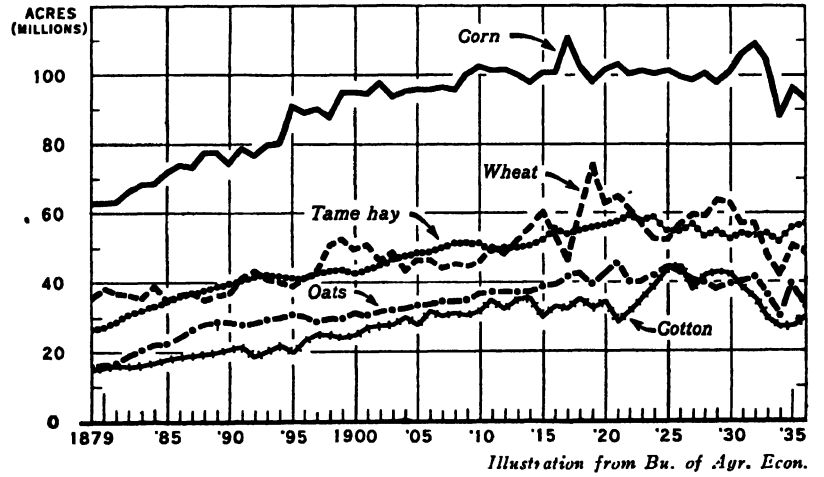


Fig. 60. Principal crops: acreage, 1879-1936.

uct with so many different uses and well adapted for growing on newly cleared land. The acreage in corn in the United States is usually a little less than the combined acreages of wheat, oats, barley, and rye, but the value of harvested corn ranges from 50 to more than 100 per cent greater than the combined values of the other four grains. Corn is grown normally on about 30 per cent of the land in harvested crops, and contributes from 20 to 25 per cent of the total income from farm crops.

Uses. The protein content of corn is about two thirds that of wheat, but it is of a type that does not become sticky when wet, and, therefore, the flour cannot be made into light bread. This limits the use of corn for human consumption. However, its

adaptability to the geographic conditions of the South has made it an important article of diet there. It is also used in the manufacture of breakfast foods, corn starch, syrup, liquors, and other products. In 1937 about 33 million bushels were used in the manufacture of whisky and 8 or 10 million bushels in the manufacture of beer. The grain has a high starch and oil content, which adapts it to the fattening of animals, the leading use of the crop. It is so important in the fattening of hogs, accounting for more than two thirds of the feed cost for producing hogs, that the relationship

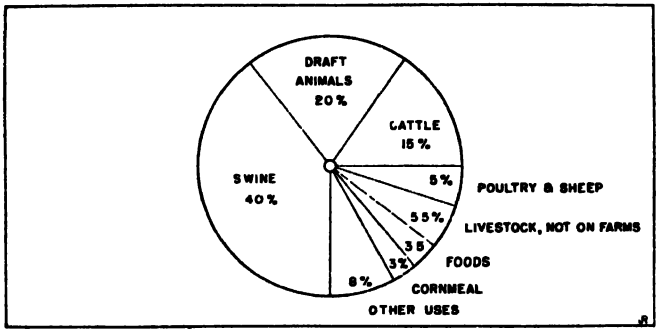


Fig. 61. Relative importance of the different uses of corn. (Source of figures: Converse, *Elements of Marketing*, 1935, p. 553.)

between the prices of the two products is shown by the corn-hog ratio. Over a long period it has been found that 11.3 bushels of corn are equal in price to 100 pounds of live hogs in Chicago. When the ratio is below this average, it is usually deemed profitable to sell the corn instead of feeding it; when above, to feed it.

Natural requirements. Corn is one of the cereals most sensitive to climatic conditions. It is a plant of the warm or subtropical type of summer that is found in the central and southern United States with its hot days and nights and frequent thunder showers. There are varieties with different lengths of growing season, but the crop is not profitable for grain where the growing season is shorter than five months. Hot nights are necessary when the plant is tasseling and the ears are setting on. Not much corn is grown where the average summer temperature is less than

66° or where the average night temperature of the three summer months is below 55°. At present, however, the northern limit of profitable corn culture in the United States is one hundred miles farther north than was thought possible in 1865. The use of the silo and development of new varieties have both been factors in this expansion. About 10 or 15 inches of rainfall during the growing season and an annual rainfall of 25 to 40 inches is necessary. Tests have shown that in the corn belt there is a close relation between the yield and the amount of summer rainfall, especially the July rainfall. Dry, hot weather or extremely high temperatures are detrimental. Even though there may be sufficient soil moisture, excessive temperatures remove moisture from the tassels faster than it can be replaced. Such temperatures may also injure the tassels before the ears have had a chance to be pollenized. Dry autumns, to hasten maturity and to lower the water content in the ripened grain, are important. Wet autumns, by delaying maturity, increase the danger of the grain's being frosted.

Corn will grow on a wide variety of soils, but the best yields are obtained on fertile, well-drained dark loams with a high percentage of organic matter and available nitrogen. Recent experiments have shown that the crops grown on the more fertile soils are least susceptible to frost damage, either in the spring or in the fall of the year.

There are many varieties of corn, with varying degrees of susceptibility to the different influences of climate. Much has been accomplished by the work continually under way at experiment stations in the corn belt in the developing of varieties more resistant to cold and drought. It should be evident that the area best adapted to corn is rather limited. This limitation and the productivity of the crop indicate its importance in the corn belt.

Regions of production. Corn is grown over practically all the eastern half of the country, with the exception of a small margin along sections of the Canadian boundary. The *corn belt,* however, extends from central Ohio to central Nebraska (Fig. 6). The center of heaviest production extends from central Illinois

to eastern Nebraska. Even in the corn belt less than half of the land is planted to corn. Small grains, hay, and pasture occupy the remainder. This practice gives the farmers several crops on which to rely, and makes possible a better distribution of farm labor. It is also an aid in maintaining soil fertility and provides forage for large numbers of livestock. Climate is a major factor in determining the combinations of crops. In the northern part of the corn belt, oats are the leading small grain; in the southern part, winter wheat predominates. West of the Missouri River alfalfa is the chief hay crop; in the moister East, clover and timothy are most important. The average corn farm also has some pasture land.

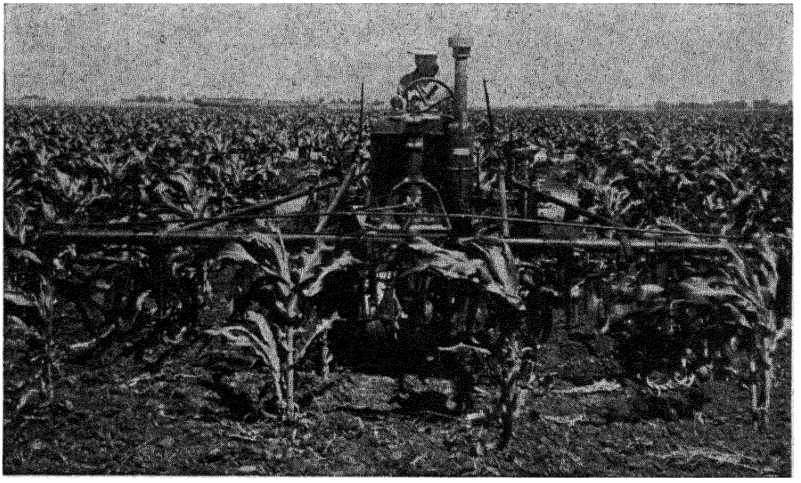
About 75 per cent of the crop is usually fed to the livestock on the farms on which it is grown. But because of the longer distances to the corn-deficiency areas, the nearness of the section to the western ranges, and the greater relative importance of grazing within the area, the fattening of animals is of much greater relative importance in the western part of the corn belt. Grain for the importing markets of the Eastern and Southern States, for export, and for manufacture into corn products is supplied chiefly by Illinois. In the districts of heaviest animal feeding, however, farmers with a small surplus of grain sell to those who must buy feed, either directly or through the medium of the local elevator, which also ships seasonal surpluses to the larger terminal markets.

Iowa, Illinois, and Nebraska combined normally produce almost 40 per cent of our corn crop, contributing about 16, 12, and 9 per cent, respectively. Missouri and Kansas are next, each with about 6 per cent, followed closely by Minnesota, Indiana, Ohio, and South Dakota. North central Illinois and the Missouri River basin of Iowa and Nebraska have the best combination of soil and climate for corn. Outward from these centers the soil or climate, or both, become less favorable for the crop.

In the cotton belt corn usually occupies about 75 per cent as much acreage as cotton. The acreage in corn averages about half that of the corn belt, and the production about 30 per cent as much.

It is grown as a supply rather than a money crop, and only about half enough is grown to meet demand. Competition from cotton is too keen for much expansion of the acreage that is planted with corn.

Future of the corn belt. Many variables are met when one tries to outline the future prospects for the corn belt. Vegetable oils are being used increasingly as a food in place of animal fats. Our exports of meat and lard have already declined seriously as a result of economic nationalism, and once new industries are started or existing ones expanded, it is not easy to abandon them. The



College of Agriculture, U. of Illinois.

Fig. 62. Four-row corn cultivator on Illinois farm.

long-range policy of our own government toward agriculture is uncertain. Erosion is a serious problem in parts of the corn belt; and as the soil loses its fertility, corn may become a less profitable crop. Erosion may be for the most part controlled; but the spread of mechanized farming tends to discourage the rotation of crops, the chief method used at present to control erosion, because there is a smaller number of horses remaining to consume the other crops that might be grown. Erosion can be controlled by other methods, but they are more expensive. Mechanized equipment is more economical on large farms, and, since land is cheaper in the

western part of the corn belt, production may concentrate there still more.

Finally, through the results of scientific research, we may be able to turn a portion of the crop into an industrial raw material whose market will be limited only by its ability to compete with other industrial products and by consumer purchasing power rather than by the size of man's appetite for food. Corn contains many by-products in addition to corn starch, syrup, and oil, which may be turned into valuable chemicals. Its possibilities as a source of motor fuel have already been mentioned. The stalks may be used for making paper and other cellulose products. The realization of these possibilities might greatly increase the acreage in the crop.

In spite of unfavorable factors, however, corn will continue to be the leading crop over much of the area where it is now grown. The region is adapted to corn, and there are no other staple crops in which it can compete extensively with other regions. A less profitable corn-growing industry will mean a lower standard of living for corn-belt farmers.

WHEAT

Qualities. Wheat is used almost entirely for human food in the form of white bread. Bread can be made from the flour of other cereals, but wheat, because of the glutenin and gliadin which it contains, makes a flour that is lighter and that rises better than the flour from any other cereal. The dough is strong enough to retain the gases produced by fermentation and to rise with them. People also like the taste of wheat bread best and usually turn to it from other kinds of flour when their standard of living permits. For this reason it is called the luxury cereal.

Natural requirements. Wheat grows best in the drier parts of the middle latitudes, and most of the world's crop grows in regions with not over 30 inches of rainfall. Experiments have shown that the best results are obtained where rainfall is from 30 to 35 inches, and wheat growing is not successful where rainfall is above 45

inches. In the regions of heavier rainfall, with their poorer soils, the plant is attacked more by disease and is open to the danger of the stalks falling and the kernels shriveling. Harvesting, too, is more difficult in such regions. The minimum amount of moisture necessary in the United States is about 15 inches annually. The plant, however, will grow with a minimum of 8 inches where other conditions are more favorable than they are here. Though it cannot withstand excessive cold or periods of successive freezing and thawing, the wheat plant is highly adaptable, and, therefore, numerous varieties have been developed for growing under different climatic conditions. Wheats may be classed as hard wheat and soft wheat. The former grows in cool, dry regions, particularly where the ripening season is dry, and the latter in the warmer, more moist parts of the middle latitudes.

The plant does well on a wide range of soils, but the optimum soils are well-drained silts, silt loams, and clay loams, having high fertility, fine texture, and high humus content. The black soils, rich in nitrates, of the northwestern United States and Canada and of Russia, produce wheat of higher protein content than other soils. The quality of wheat, however, is more dependent on climate than on soil.

Classes of wheat. Wheat is classified according to the season of planting as spring wheat and winter wheat. Conditions of temperature and rainfall determine the variety to be grown. In the northern United States the winters are too cold for winter wheat to live through; consequently the entire crop, with the exception of the production of a few sheltered locations, is of spring varieties. The northern limit for winter wheat is a mean summer temperature of 58°. About 75 per cent of the world's wheat is winter wheat. In most places it returns a higher yield than spring wheat.

For marketing purposes five classes have been established in the United States: hard red spring, hard red winter, soft red winter, white, and durum. One third of the crop of the United States is hard red winter wheat. Hard red spring and soft red winter

wheat each contribute about 25 per cent, and until recently white wheat and durum wheat were about equal in quantity. Recent droughts have caused a marked decline in the durum wheat crop.

Baking quality (ability of the gluten to stretch without breaking, so that it will make a large loaf) and milling quality (amount of flour per bushel of wheat) determine the uses and relative values of the various classes of wheat. Hard red spring wheats of the United States and Canada are equal in baking quality, but those of Canada have the highest milling quality of any wheats. Soft red winter wheat and white wheat are the equal of the above in baking quality, but are lower in milling quality. Both are used for blends and for pastry flours, and white wheat for breakfast cereals. Durum (meaning *hard*) wheat is a spring variety which grows well in regions of light rainfall. It is used largely for pastry flour, macaroni, and spaghetti.

Regions of production. The United States has two important wheat regions (Fig. 6), the eastern part of Washington and Oregon and the central plain from northern Texas to Canada, with an eastward extension between the main corn and tobacco regions.

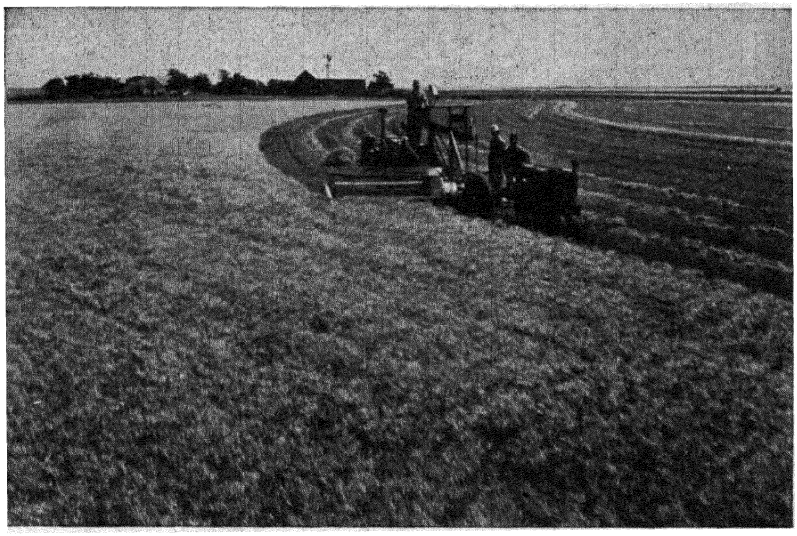
In Washington and Oregon, the lava soil and excellent wheat climate combined make an ideal wheat-growing section. Because of dry summers the ripe wheat may be left standing in the field for weeks. This permits the use of large-scale modern machinery in harvesting. The acreage adapted to wheat is relatively small, however, and the distance to market is long. White wheats of both winter and spring varieties are grown.

In the central plain both the winter- and spring-wheat regions are found, with the line of demarcation along the northern edge of Nebraska. North of this line, the winters are too cold for winter wheat; south of it, the early summer becomes too hot for spring wheat. The Red River Valley is the center of spring-wheat production.

Central Kansas is the leading winter-wheat area. Here the rainfall is such that other crops cannot be easily grown. From this area, the winter-wheat region extends westward into the semiarid

districts and eastward through the southern part of the corn belt to the Atlantic coast. These more eastern sections are near wheat-consuming centers and can thus profitably market a certain amount of wheat. It is also grown in systems of crop rotation and as a crop that does not compete seriously with other crops for labor. Districts with clay soils are usually the ones of densest production.

Expansion into the drier part of the plains resulted from a period



Soil Conservation Service, Salina, Kansas.

Fig. 63. Harvester-thresher at work on the contour on a terraced wheat field in Kansas. This practice keeps machinery tracks from being made up and down the slopes, thus eliminating the danger of gully formation.

of heavier rainfall and high prices at the time of the World War, and from the application of automotive machinery to wheat farming since then. The tractor has made possible the farming of much land by one person. Thus, in the absence of extreme drought, the grower has a better chance of obtaining enough income to maintain a family than he had with the older, nonmechanized methods. The truck has also made possible the marketing of wheat from locations distant from railways. Cheap land, extensive equipment, and the consequent low cost of pro-

duction were important factors in creating the glutted markets of the early thirties. Drought and dust storms have recently caused widespread damage in this dry area.

Hot, humid conditions limit wheat growing in the South, as do the open winters, which, by keeping the plant growing, expose it to the dangers of occasional late frosts. Neither is wheat growing adapted to the type of farm organization which prevails in the South.

Foreign commerce in wheat. For several years previous to 1928, we exported 20 to 25 per cent of our wheat crop, but now, because of the preferential tariff system of the British, and protective tariffs in other countries, this trade has all but disappeared. On the continent of Europe, wheat production has expanded by about 300 million bushels; Canada has gained an important advantage in Great Britain, the leading market for exported wheat. In view of these facts it is not surprising that our exports have practically vanished and that there have been overproduction and low prices for the crop. However, for some time the trend of our exports had been downward, and agricultural economists had long predicted that we would be compelled, before many years, to import to meet the domestic demand. Temporarily, owing to continued drought, our imports have exceeded the exports. On the other hand, long summers that are too dry for corn have resulted in a marked increase in the acreage of wheat in the southwestern part of the corn belt; this may temporarily provide a greater surplus for exports if conditions are normal in the main wheat-growing areas.

For some time before the recent series of droughts, from 40 to 50 per cent of our exports of wheat had been in the form of flour. Recently, since we have had to import wheat, almost the entire wheat exports at times have been of flour, indicating that certain countries depend upon our mills for their flour. But because nations which import breadstuffs tend to give their milling industry tariff protection in order to have the added wealth and employ-

ment for labor, importing instead the raw material, our exports of flour have been declining. Our leading markets for flour at present are in our foreign possessions, Cuba, and Central America.

The future of wheat growing. An important fact about wheat is that to a large extent it is a frontier crop. Frontiers are caused either by newness or by an unfavorable climate, the former type tending to disappear, the latter being permanent. The ease of growing, storing, and transporting wheat and the widespread demand for it adapt it to such frontier regions, and, so long as people live in them, the crop will be grown. As was stated previously, the mechanization of wheat growing has encouraged expansion in the frontiers because of the low cost of the land. Our Federal Government is now encouraging people to move from the drier parts of the Great Plains in order that an attempt may be made to get the wheat land seeded to grass as a means of controlling the dust storms which have recently become a serious menace. However, it is usually difficult to move people, because they have a capital investment which they hesitate to abandon. For these reasons such regions will continue to be an important factor in supplying wheat.

Several factors may encourage greater production in this country. The completion of the Great Lakes-St. Lawrence waterway project would give some added advantage in exporting. Compared with that of European countries our yield is low. Several new varieties that are more productive and more resistant to rust than the old have been introduced recently. This, coupled with the fact that in some places wheat farmers are starting to apply commercial fertilizer to their lands—which increases the yield, hastens maturity, and makes the wheat more rust resistant—may so decrease the unit cost that wheat will become a more profitable crop in systems of rotation in the moister parts of the grain belt, as well as a more dependable crop in the leading wheat districts.

The possible actions of foreign governments toward their wheat industries must also be considered. Several European nations

have encouraged a home industry in order to have a better supply of food in case of war. Also, in several European countries economic activity can be and has been directed into channels that it would not follow under a laissez-faire policy. Changes in policy can be made suddenly and enforced. The growers in at least one country have been given an artificial advantage through favorable freight rates on exports; and in our own country by means of the benefit payments which have been made since 1933. These, and other influences, all have an important bearing on the prosperity of the wheat grower in this country.

OATS

Uses and qualities. Although the use of oatmeal as human food is increasing, and some people of northern Europe eat oaten bread, the chief use of oats is for horse feed. For this purpose oats are without a rival, especially in warm weather. They have a high protein content and thus give spirit and energy to animals, are excellent for building bone and muscle in young stock, and are important for feeding dairy cows. Oats are about equal to corn in food value.

Natural requirements. Oats, thought to have originated in the northern latitudes, are at home in a cool, moist climate like that of northern Europe. The plant has a short growing season and will stand considerably more moisture than corn or barley. Most varieties will not stand much dry weather, although the high-yielding Kherson oats and related varieties, introduced into the United States from southern Russia, are tolerant of drought. Not being resistant to cold weather, oats are generally a spring-sown crop.

Although the distribution of the crop is not influenced much by soil and although oats are less exacting as to soil than any other cereal except wheat, a moderately rich soil high in humus content is best. Oats grow well on moist, sandy soil; on rich soil they are likely to lodge. Being spring sown and having a shorter growing season than spring wheat, oats are a competitor of spring

wheat; this pushes oats to the north of the wheat areas whenever they compete for land. The sections of heaviest production are along the cooler margin of the corn belt.

Types of oats. Oats may be either spring sown or fall sown, depending upon the climate. Practically the entire production is spring sown. When fall sown, a different variety (red oats), adapted to warm climates, is planted, although it may also be planted in the spring. In the South and along the Pacific coast, the crop is sown in the fall for both grain and forage; in some dry sections it is planted in the fall and cut for hay just before maturity. Where possible it is an advantage to plant in the fall because a cover and winter-pasture crop is provided, a better distribution of farm labor is obtained, and the land is available earlier in the summer for other crops. The fall-sown variety is also more productive.

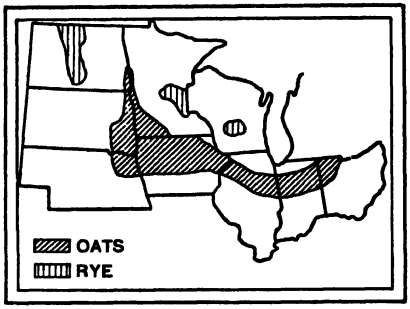


Fig. 64. Principal oats- and rye-producing areas of the United States.

Regions of production. Oats are grown extensively in the corn belt because of the demand for feed for horses, young fattening animals, and dairy cows, and because they fit well in a rotation and dovetail well with corn with regard to labor requirements. They are also used as a nurse crop for hay. They commonly follow corn and wheat, using the land when it is poorest. In the spring-wheat belt, they are grown both for feed and for an added crop.

In spite of the decline in the number of horses, beginning with the introduction of the tractor about 1920, the acreage, production, and price of oats, if we omit the effects of the recent depression on prices and of the recent droughts on production, have tended to remain constant. The marked increase in the production of dairy products after 1920 caused more oats to be used in dairy

farming, and it may be that farmers fed relatively more oats than other grains to their draft animals than they had previously. The effect of the more recent introduction of the small tractor on the production of oats remains to be seen.

Iowa normally leads the states in the production of oats, with about 17 per cent of the total crop; Minnesota produces 13, Illinois 12, Wisconsin 8, and Nebraska 6 per cent.

Because of low value and bulk, which discourage shipment for long distances, oats are usually fed locally; when manufactured into breakfast foods for human consumption, they can be shipped profitably. Although oats comprise about 50 per cent of the total quantity of cereals manufactured into breakfast foods, only slightly more than 1 per cent of our total production of oats is used for this purpose.

BARLEY

Uses. Barley, in the form of both grain and hay, is used chiefly for feed. With skim milk, it is excellent for producing bacon hogs, and it is often used for this purpose in dairy regions. Next in importance is its use for alcoholic liquors. About 60 million bushels are now used annually for beer in the United States. For a decade or more previous to 1929, one sixth of our annual crop had been exported to European brewers; now only two or three per cent is exported. Barley, though it resembles wheat in composition and is cheap to produce, lacks the gluten necessary to make good bread. If this element were present, it probably would be used much more extensively, because of its yield and the wide range of conditions under which it will grow. It is a good substitute, however, for corn and oats for animals in regions where those crops cannot be grown, and in many places yields more feed per acre than oats. As a fattener it is 90 to 95 per cent as valuable as corn. The famous Arabian horses are fed on barley. It was the chief bread plant of the ancient world because of its productivity in the Mediterranean climate.

Natural requirements. Barley, the hardiest of the cereals and the least susceptible to disease, will grow from the dry subtropics to beyond the Arctic Circle. Although the wide distribution is largely due to its short growing season (80 days in Alaska), it is also due in a measure to the ability of the plant to resist drought, heat, and cold. While most varieties cannot withstand much wet weather, particularly under high temperatures, some are tolerant of moisture in both soil and air. Although in the Imperial Valley barley grows under summer temperatures of 95° and annual rainfall of less than 10 inches, and in Colorado at an altitude of 10,000 feet, with summer temperatures as low as 52° and with frequent frosts, the principal growing regions have a distribution similar to that of wheat. Under a combination of cool summers and rich, well-drained soil, barley yields higher than any other small grain.

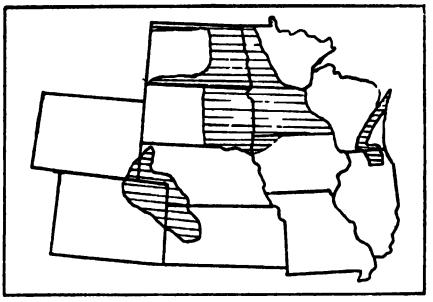


Fig. 65. Principal barley-producing areas of the Plains region.

While barley does best on good soil, it thrives on alkali soils and on soils that are too poor for wheat; indeed it often replaces that crop on soils when they become too poor for successful wheat production. In southeastern Minnesota, the line of glaciation separates the regions of heavy wheat and heavy barley production; the barley grows on the older glaciated and more leached soils.

Regions of production. The principal barley region (Fig. 65) coincides with the spring-wheat belt. Minnesota and North Dakota each grow 15 per cent of the total crop. Other centers are in northwestern Kansas and the adjacent parts of neighboring states, and in central California—regions with good soil but with too little rainfall to grow other crops dependably. In California barley is grown as a winter crop, often on land that has become too poor for wheat. In the spring-wheat belt, it is cultivated be-

cause it adds diversity to farming and dovetails with wheat in its labor requirements. It can be planted later than other crops, with better chances for success; when planted early, it matures ahead of drought and attacks of rust.

RYE

Uses. Next to wheat, rye is the world's chief bread grain, but in the United States its use as a breadstuff is rather insignificant. It is a staple article of diet in large areas of Europe where the standard of living will not permit the purchase of wheat bread or where the soil is not adapted to wheat growing. It is thus called the poor man's bread. It contains enough protein to make a flour of moderate strength. Rye bread is slightly less nutritious than wheat bread, and its color and flavor are less desirable. Most of the grain in this country is used for feeding swine. Its feeding value is from 85 to 90 per cent that of corn. About 12 million bushels are now used annually for the manufacture of whisky.

Natural requirements. The optimum conditions for rye are about the same as for wheat, but rye is more resistant to cold and less resistant to dry weather. It is not so exacting in its soil requirements as wheat, and gives good yields on rugged lands and on soils of low fertility or on those that are poorly drained. It is not as subject to the attack of insects as are the other small grains and not as subject to disease as wheat. In the United States the chief centers have a mean summer temperature of about 70°. Not much is grown for grain where the mean summer temperature is over 75° or where the mean winter temperature is lower than 15°.

Regions of production. The chief area of rye production (Fig. 64) is nearly coincident with the spring-wheat belt. Farther east it is grown on poorly drained, nonfertile soils. In the spring-wheat region, however, rye is not important in the Red River Valley, but on the drier soils to the west. Since rye matures early, the crop escapes the heat and drought of the latter part of the summer. It is grown widely in the spring-wheat area in order that

capital and labor on the farms may be utilized more efficiently. It is a fall-sown crop and can be harvested before the wheat is ripe.

Rye is also grown as a cover crop, for fall and early spring pasture, and for plowing under as a green manure, especially in the South. In New England it is often the first crop in a rotation to build up worn-out soil. Near some of the large industrial centers it is grown for packing straw, which is often as valuable as the grain. This straw is used for packing fruit trees, pottery, and other articles, and for making paper. North Dakota usually grows about a third of the crop and Minnesota a sixth.

BUCKWHEAT

Uses. For human consumption, buckwheat is used alone for griddle cakes and as an ingredient of some of the prepared pancake flours; it is also used for making liquor. It is an important feed grain, especially for poultry, in the regions where grown; and it is often planted in preserves to provide food and protection for wild fowl. The plant is important as a source of honey, the flower containing much nectar, while the blossoming period is extended because all blossoms do not open at the same time. Farmers also grow it as a crop to plow under for green manure.

Natural requirements. Buckwheat grows early and matures rapidly, doing best in a cool, moist climate on moderately fertile soil, lodging badly on fertile soil. Its great advantage, however, is the fact that it yields better than other cereals on poor soil. Little is grown where the mean summer temperature is above 70°; the plant is very sensitive to frost and drought, and the blossoms do not fertilize well in hot weather. In view of its short growing season, it is thus adapted to cool uplands, regions where poor soil usually is found. A crop may be planted as late as the first part of July, for which reason it is planted often as a catch crop after other crops have failed. When it is plowed under green, two crops may be grown in a year.

Regions of production. Almost the entire production of buckwheat is in the northeastern quarter of the country, being grown

principally in the Appalachian highlands but also in the region of the Great Lakes. Pennsylvania and New York each supply about one third the total production. The greatest center is near Binghamton, New York. It is also grown in the lake plain in connection with the honey industry. The only other important state is Minnesota, where the crop has been introduced only recently. The acreage planted ranges from seven to eight hundred thousand, with a normal yield of about 18 bushels an acre. There has been no marked tendency for the acreage or the production to change for a half century or more, but the price has recently had an upward trend.

SUMMARY

Commercial movements of cereals. Commercial supplies of various cereals move from areas of surplus production by rail, lake, and river to processing centers, which are discussed in Chapter 19, to deficiency areas in the Northeast and South, and to the ports of the Atlantic, the Gulf, and the Pacific for export. This provides a tremendous tonnage for our transportation agencies, which give encouragement by special rates and other privileges, and often causes a shortage of rail facilities when crop movements are heavy. Organization and means for collection and for storage and facilities for rapid loading and unloading provided by agencies distinct from the railways are necessary. Deficiency areas require grain for human use and for animal feed, and while much moves over the Great Lakes and the Mississippi River, the bulk of the shipments are by rail. Grain shipped over the Great Lakes may be unloaded at the southern lake ports or go on to Montreal for export; that moving by the Mississippi may go to New Orleans for export or stop there or at some other point for domestic consumption. Because of the competing rates of the railroads serving the respective ports, the Gulf ports of Texas and Louisiana compete keenly with those along the Atlantic from Norfolk northward. New York is an important exporting point because shipping concentrates there, and because liners, which must depart on sched-

ule, are willing to give relatively low rates in order to have as much cargo as possible, in case there is only a partial load as sailing time approaches. New England ports are more important in winter, when the St. Lawrence is frozen. On the Pacific Ocean side of the continent, Portland and the Puget Sound cities handle most of the exports.

Export trade in cereals other than wheat. Although cereals other than wheat never have been important among our exports, they were more important previous to 1929 than they now are, and even before that date the quantities exported had been declining for several years. The recent marked reduction is not alone because of the droughts in this country but also because of the greater production of rye, corn, and barley in Europe, the leading export market. The exports of these cereals had always been small though, on account of their bulk and cheapness, the poor shipping qualities of corn, and the more favorable location of some of the foreign producing centers with respect to world markets.

Production of cereals. Basically, cereals stand foremost among the foodstuffs of man. Since they are a necessity, the quantity grown does not tend to be influenced much by changes in the business cycle. High prices do tend to encourage greater production, but low prices do not result in a decline, this being characteristic of all cereals in the United States, and also in some other countries, since 1920. There is even a tendency for low prices to cause an increase in the acreages planted. This is because farmers can meet their overhead or fixed costs, when prices decline, only by growing a greater quantity, and because farmers in countries which import a part of their supply obtain legislation, usually protective tariffs, to bolster their industry. This results in greater production in those countries, but not corresponding reductions in the ones which formerly supplied them. The United States Department of Agriculture has found that 15 years are required for farmers in the United States to readjust their operations to a new set of conditions.

Factors other than declining exports and the lag in readjustment, which have recently affected cereal production in this country, are the migration of people to the city, where relatively fewer cereals are used in the diet; the declining number of draft animals; and the lack of alternative crops in some places. Counteracting these adverse influences to some degree are recent trade agreements and the return of legalized liquors.

9
HAY AND FORAGE CROPS

FOR the development of a permanent agriculture, a system of mixed farming based on cereals, livestock, and forage crops is generally recognized to be superior to a system of specialized farming. For example, our northern Great Plains, with all its potentialities, is especially hard hit and retarded in progress by agricultural depression, because of a lack of adapted forage crops. On the other hand, considerable economic stability has been attained in the southern Great Plains by combining crop and livestock production, the introduction of sorghums providing a basis for the latter activity.

Mixed farming also provides humus and manure and legumes for maintaining soil fertility, improves the condition of the soil for staple crops, helps control soil erosion, and utilizes labor and equipment efficiently.

Distribution. The distribution of hay and forage shows well the joint influence of geographic and economic factors in the selection of crops to be grown in different regions. Economic factors are of chief importance, although the several crops have somewhat different geographic requirements. Such a wide range of plants is used for hay and forage that one or more will grow in almost any part of the country; no other crops are found so widely distributed over the country. Leguminous and non-leguminous hay crops, cereals cut green, and intertilled crops, such as corn and sorghums in the form of green feed, dry feed, and ensilage, are all used for fodder purposes. The chief legumes grown are alfalfa, clover, peanuts, and field beans of various sorts. The most important nonlegumes are timothy, the bent grasses,

redtop, and wild grasses. Legumes have a higher content of protein and mineral matter than nonlegumes. During recent years there has been a shift to the legumes, and at the same time a marked increase in the use of the annual legumes.

It is difficult to estimate the total acreage and production of hay and forage crops. Some crops, such as hay, are used entirely as forage. In others the fruit or grain may be harvested, leaving, as in wheat and corn, the straw and stalks, respectively, for forage. Wheat may also be pastured or it may be cut green for hay. There

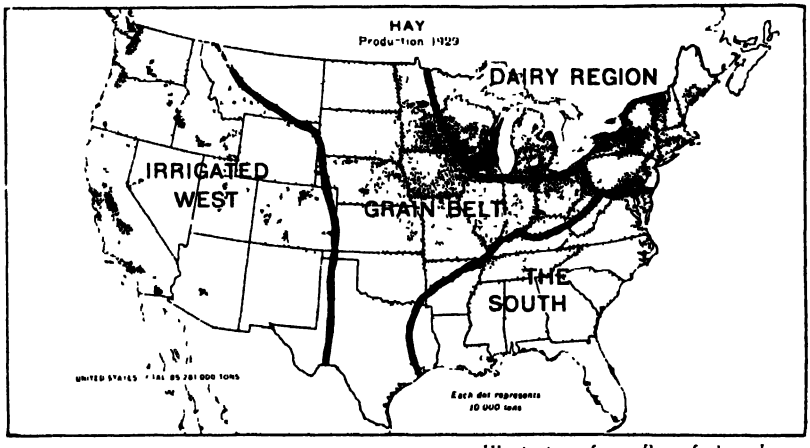


Illustration from Bu of Agr Econ.

Fig. 66 The hay-producing regions and distribution of hay production in the United States (hay regions drawn by the author).

may also be, as in the case of sugar beets, by-products that may be fed. Of hay crops alone there are about 68 million acres, with an annual crop valued normally at about $800,000,000. Only corn outranks hay crops in acreage, and only corn and cotton in value, although wheat is only slightly behind.

The country may be divided into four hay and forage regions (Fig. 66): (1) the northeastern dairy region, (2) the grain belt, (3) the warm, humid Southern States, and (4) the rugged West. The former two are the leading areas, the corn belt growing more forage than any other area of equal size in the world.

The northeastern dairy region. In the dairy region are found ideal conditions for growing hay and grass. In addition, much of the area is near the great markets for fresh milk. The climate is cool and moist, the rainfall not being heavy but well distributed and dependable, and there are plenty of rainless periods for the curing of hay. The heavy snowfall in winter prevents injury to the grass roots through successive periods of freezing and thawing. The soils are glacial and, since they retain water well, are excellent for grass. There is also much hilly land and many poorly drained and infertile spots. All of the geographic factors combine to prevent the extensive growing of other crops. Also, less labor is required to grow hay than to grow cultivated crops, an important consideration on a dairy farm, where tending the cows requires a relatively large amount of labor. The principal reason for the lack of extensive grain farming, however, is inability to compete with other sections; also, the other use of the land is more profitable.

The leading forage crops of this region are timothy and clover mixed, and corn for ensilage. Clover and timothy are grown alone to some extent. Redtop and orchard grass are grown extensively in New England and southeastern New York. Some of the ensilage is a by-product of the corn-canning industry, which is important in various parts of the dairy belt. Alfalfa is an important crop in southern Michigan and eastern Wisconsin, and to a lesser extent in the lake plain in New York.

The grain belt. Both economic and geographic influences are important in the selection of forage crops in the grain belt. The crops are needed as a winter feed for draft, dairy, and fattening animals, and their bulk prevents shipment for long distances, especially when the quantities fed are large. These crops also fit well into rotations, economize labor, and are valuable in adding fertility and humus to the soil.

East of the Missouri River, timothy and clover, both alone and mixed, predominate. Timothy, alone, is important because clover

is not a good horse feed. Many farmers have a slight amount of clover with the timothy, because timothy alone is not a soil-building crop, except that it will give the soil a rest from other crops and prevent erosion. Clover may be fed to cattle, however, and much is grown to build up the soil. A considerable amount is also grown for seed. Timothy is better adapted to heavy, sour soils than is clover. When they are mixed, it is usually on the better soils. Timothy is not grown extensively south of the Ohio River Valley, nor does it compete much with alfalfa in the drier region west of the Missouri River. Ensilage and fodders are important throughout the grain belt, and recently the growing of soybeans for forage has increased in the eastern part.

In the spring-wheat region and parts of the winter-wheat region, native or wild grasses, important in expanding livestock production throughout this region, are the leading hay crops. There is a large acreage of alfalfa, however, in the Missouri River Valley in Kansas, Nebraska, and South Dakota, and the crop has been expanding into the Red River Valley. The alfalfa plant has a long taproot, an advantage in this moderately dry region. The large number of animals in the region provides a ready market for the crop. Sweet clover, for years a roadside weed in the western part of the corn belt, is now an important crop in the spring-wheat region and provides the basis for a honey industry. It is more resistant to cold and drought than other clovers, and is thus well adapted to the spring-wheat district. It is used but little for hay, however, being used principally as a rotation pasture crop, and will carry more animals per acre than most other pasture crops. The plant will grow on a wide variety of soils and is one of the few that is profitable on poor soil. In the northern plains large quantities of the small grains are also cut for forage. In the drier, warmer parts of the region the sorghums, either as fodder or ensilage, are becoming more important.

One important feature of the production of native grasses and of timothy, both alone and mixed with clover, is that they are being grown more on the margins of the leading grain areas. This

indicates the relative profitableness of the two crops. Because of the relative cost of transporting animals and grain to market, animals also tend to be grown more on the edges than near the center of the grain areas. This practice locates the main demand for hay near the margins of the grain area, especially in the corn belt.

On the dry southwestern margin of the grain belt sorghums are a major crop. These plants, "the camels of the plant world," remain dormant during drought and then resume growth when rain falls. Furthermore, they have a short growing season. Sorghums are adapted to various types of loam soils and do better on poor soils than do most crops. They thrive in the corn belt but cannot compete with corn for land. The farmers of this dry region find these crops advantageous because they furnish both grain and forage for livestock and grain for a money crop, and they also aid in the diversifying of agriculture, which has been a difficult problem. In other agricultural sections farmers have become aware of the advantages of these crops, and are now growing them to some extent in place of hay crops.

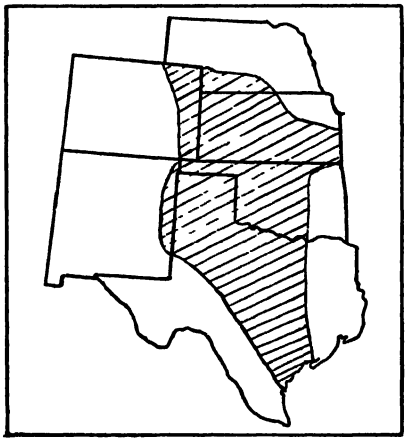
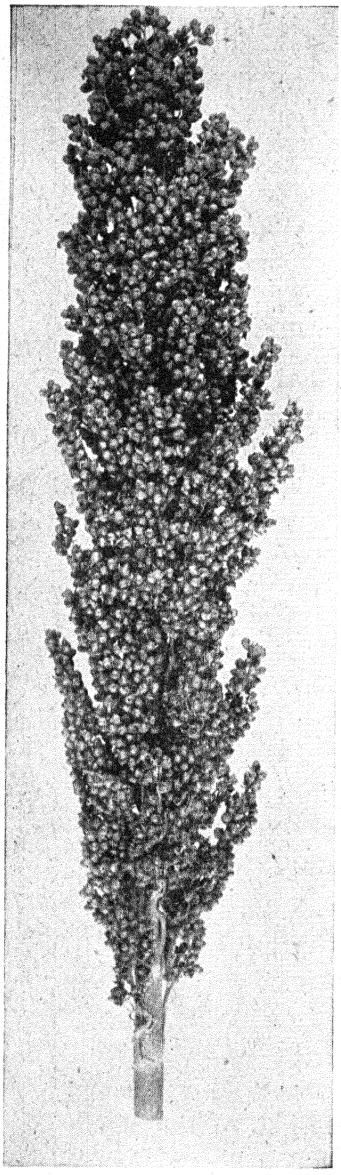


Fig. 67. Principal sorghum-growing area of the United States.

There are three classes of sorghums: (1) the grain sorghums (kaffir and milo), (2) the sorgos (sweet sorghums), and (3) Sudan grass, the last of which is used for pasture and hay. A fourth class, broom corn, is the source of straw for brooms; nearly the entire crop is grown in western Oklahoma.

Millet is grown nearly altogether as a forage crop, although a small amount of the grain is fed in the northern plains, where corn and sorghums will not mature. Since different varieties are adapted to varying conditions, its growth is widely distributed.



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Fig. 68. Typical head of Red Kaffir corn.

It is grown chiefly in the subhumid parts of the plains and extends eastward into the winter-wheat belt. The leading area is along the southwestern edge of the corn belt.

Millet is grown largely as a catch crop, being planted after others, especially corn and clover, fail. In the East and South it is planted for smothering weeds, for a cover crop, and for ensilage and pasture.

The Southern States. Both economic and geographic factors combine against the growing of hay crops in the South. The quality of the soil and the condition in which erosion has left it make a growth of grass difficult to obtain. The frequent summer rains and the high humidity cause difficulty in curing hay. Moreover, there are no good types of grass or hay crops native to the South, and the northern ones do not thrive there. The lack of animal industries limits the demand for hay. The quantity that is needed can often be purchased more advantageously from regions that are better adapted to the production of hay. A tenant and credit system makes money crops rather than supply crops important. In spite of these difficulties the acreage in hay has expanded during the past decade, because of the

encouragement given to diversified farming and the difficulty in obtaining in some places a supply from outside sources.

The leading forage crops are grains and other crops cut green, and corn fodder. Cowpeas are important, but they have declined in favor of soybeans. Bermuda grass and Johnson grass are also utilized, as are peanuts, lespedeza, and velvet beans. The last are the best legumes for the Gulf States, and are often inter-

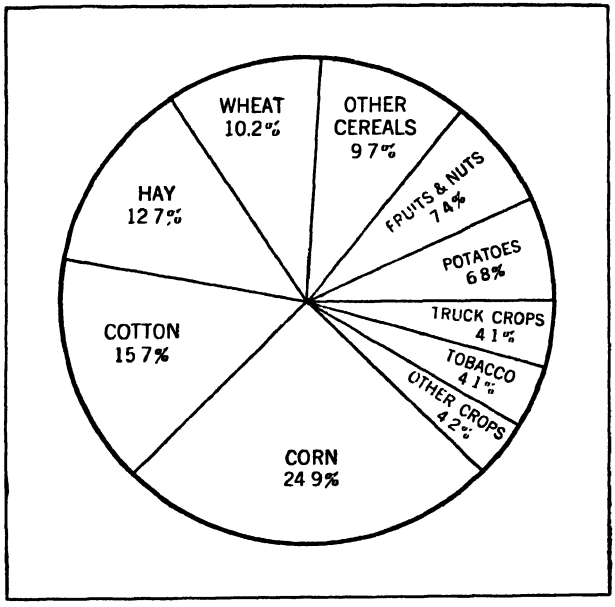
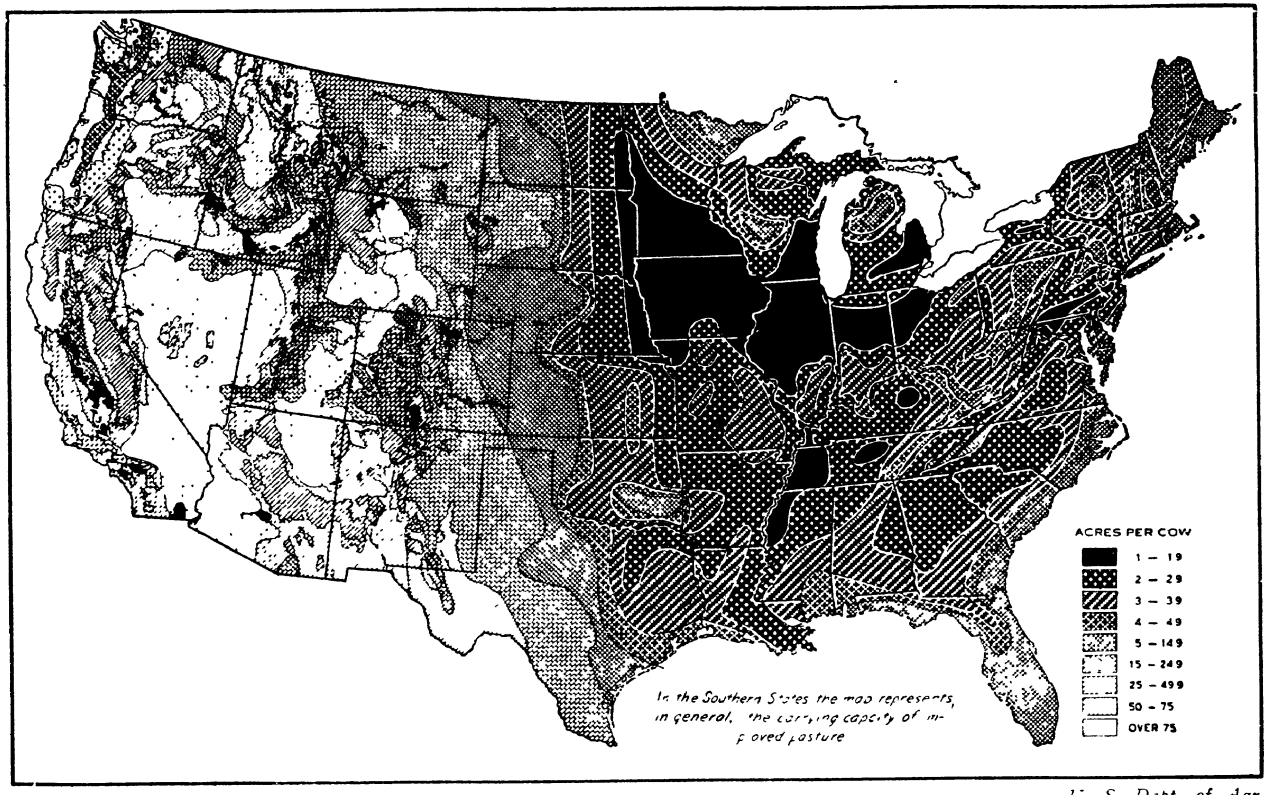


Fig. 69 Relative importance of the different crops of the United States according to value in 1936.

planted with corn or cane, and hogged down. The Southeast is the leading section for the production of annual legumes.

The West. In the West, where the grazing of cattle and sheep is important, hay and forage predominate among the crops, owing to the demand for feed during the winter months. These crops, therefore, move to market in the form of concentrated animal products. Alfalfa, which is ideally adapted to the physical conditions of the West, and which is grown largely under irrigation there, is the principal crop. Because of its feeding qualities, it is more valuable than any of the other hay crops, and, therefore, can



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Fig. 7 — Carrying capacity of pasture and range land.

stand more expensive transportation hauls than can the others. Other forage crops raised in the West are timothy, wild grasses, and grains cut green.

Commercial hay districts. The leading commercial hay districts are the western irrigated areas, central New York, northern Ohio, eastern Michigan, and eastern Kansas. Some of these are near city markets, while others are near dairy or animal-fattening districts. Sales are greater near certain of the large cities. Much hay is also sold within the region where it is grown. The alfalfa of the West enters into commerce in greater proportions than do the clover and timothy of the East. Timothy is an excellent market hay because of uniform color and ease of shipment.

PASTURES

About half of the land area of the United States is grazing land, which supplies about half of all feed consumed by domestic animals. Pastures have been called our most neglected crop. Neither the farmers nor the agricultural scientists have given them much attention. Except for the fact that grass helps to prevent erosion and that animal manure enriches the soil, one might say that the use of the nation's grazing lands had been altogether extractive or exploitive.

Although the acreage in pastures is about four times the acreage in crops (normally about 350 million acres), the net product from the crop land is somewhat greater. On comparable land the return from crops is greater per acre. In northwestern Europe the carrying capacity of pastures is double that of similar lands in this country. Pasturing is a cheap way of producing animal products. A given gain in weight in cattle costs only half as much from pasture as from feeds.

10

VEGETABLE CROPS

Importance of vegetables. Although of higher water content than many other classes of foods, vegetables form an important article of diet in nearly all countries. In addition to their direct food value, they are rich in vitamins, have a large amount of indigestible cellulose which gives bulk to the diet, and contain mineral salts as well as starch and sugar. Legumes contain 20 to 25 per cent protein. Many people, particularly those around the Mediterranean and in the Orient, where animal products are scarce, supplement starchy foods with legumes, or pulse, as they are called. Cereals, legumes, and green vegetables make a complete diet. Dehydrated vegetables have as many calories per pound as do cereals; green vegetables have one eighth as many.

The relatively large use of vegetables in the diet indicates a low standard of living. They permit of an intensive cultivation of the soil, which becomes necessary as land values increase. On high-priced land, the raising of staple cereals and the production of meat are not usually profitable. Vegetables return a great deal of food per acre because of their qualities and because several crops may be grown each year. In some instances the entire plant may be consumed.

Use in the United States. From 1919 to 1937 the volume of production of fresh vegetables increased more than two and one half times (Fig. 71). Some people think that this indicates a lowering of our standard of living; others assert that it only represents a better balancing of our diet. The American diet has changed for several reasons. Through education, there is now a better understanding of dietary problems. The migration of

people to the cities, where it is much easier to obtain fresh vegetables and other products throughout the year, has induced some change. In the city the proportion of physical labor to total labor is less than on the farms, and the hours of labor are shorter.

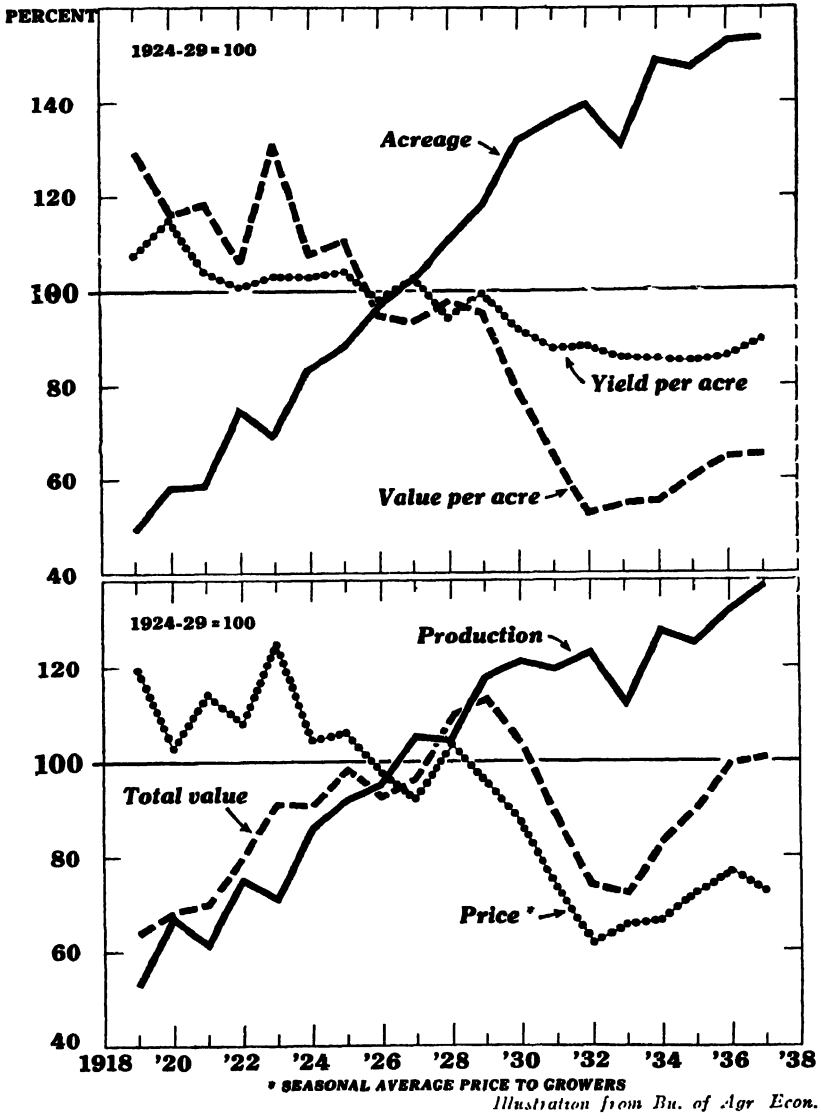


Illustration from Bu. of Agr Econ.

Fig. 71. Seventeen vegetables for fresh market shipment: indexes of acreage, yields, price, and value, 1919-1937.

People consequently require less food. The better living conditions and better dwellings of the cities have a like effect. Improved means of transportation have also been an important influence.

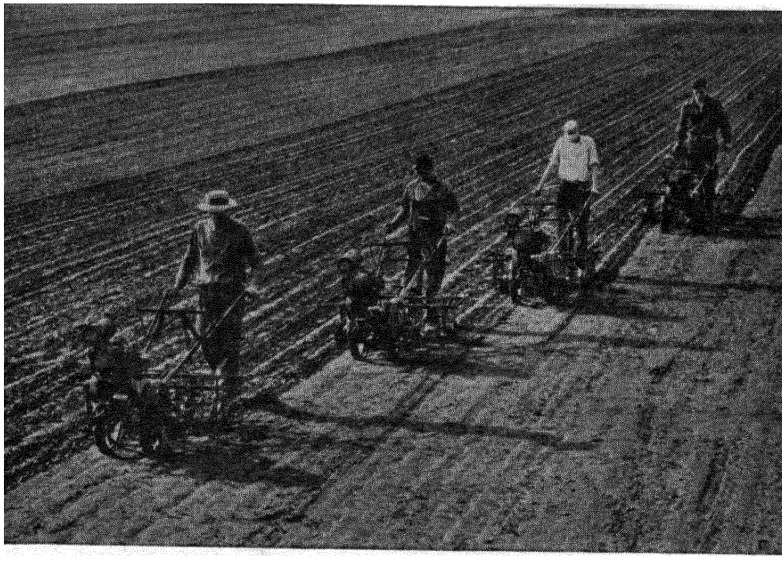
Types of vegetable farming. There are three types of vegetable farming: home gardening, market gardening, and truck farming.

The greatest intensity of *home gardening* is in the East, in areas which are not so well adapted to the extensive production of staple farm crops. Southeastern Pennsylvania, the upper Ohio Valley, the mountainous parts of the Southern States, and the west shore of Lake Michigan rank high. Eighty per cent of the farms of the nation have farm gardens, and about 80 per cent of the vegetables eaten by farmers are grown at home; no other equal part of the farm yields so great a return. For the United States as a whole, about 12 per cent of the value of all foods eaten on farms comes from these gardens. This amounts to about $70 per farm per year. Recently, Rhode Island led, with an average value per garden of $120; Pennsylvania was second, and the Rocky Mountain States ranked lowest. Some of the finest of home gardens are found in Pennsylvania. The average size ranges from one-half acre in Virginia and Massachusetts to one-fifth acre in the Plains States. Farmers are now being encouraged to grow gardens the year round wherever it is possible.

Market gardening and truck farming differ chiefly in degree. They have increased recently because of improved transportation, larger numbers of people in the cities, higher prices for meat, better means of preserving, the introduction of new vegetables, the mechanization of agriculture, which has driven farmers from the general farm to specialized vegetable farming, and better organization in growing and marketing vegetables. Vegetable farming has changed from an industry of hand labor to one of mechanized methods. A garden tractor costing about $300 permits 1 man to do the work of 10 working by hand.

Originally *truck farming* was distinguished from market gardening by its requirement for rail or water transportation to reach

markets, whereas hauling was done by wagon in market gardening. While this distinction still prevails, it is less marked since the advent of the motor truck. Market gardening is largely a summer industry, located near large centers of population, which are supplied with fresh vegetables of all kinds. Its competitive advantage lies in the speed with which fresh vegetables can be marketed to the consumer after they are harvested; there is a



S. L. Allen & Co.

Fig. 72. Garden tractors cultivating spinach. The four tractors can cultivate about 30 acres in a day.

marked advantage in the case of such perishable products as leaf lettuce or roasting ears. Market gardening also uses more labor relatively in growing the crops than does truck farming, and urban locations are favorable for obtaining it. Whereas economic factors largely determine the location of market gardening, soil and climate have more influence on truck farming, although it locates where transportation is good and land is cheap. Truck farming is both a summer and a winter industry, depending on the location, and supplies fresh vegetables to city markets at both seasons and also vegetables for canning during the summer

months. Many different crops are grown, but there is a tendency to specialize on those in more general demand and on the less perishable ones, such as cabbage, carrots, winter potatoes, or cucumbers. The farther from market a producing district is located, the greater must be the concentration on the less perishable crops. Truck farming is less intensive than market gardening, has fewer vegetables on the same farm but devotes a much larger acreage to a single crop, and employs more machinery in the operations. The same crops may be grown every year, or there may be a rotation with staple crops.

The growing of winter vegetables in greenhouses is a form of market gardening that is located in regions near the large cities, where glass, fuel, and steel are cheapest. The principal center is the district south of Lake Erie. One crop quickly follows another on highly fertilized soil, and the return per acre is high; but there is also a heavy expense for overhead on the buildings, for fertilizer, and for coal. From 200 to 500 tons of coal per acre are required each season.

The winter-vegetable industry. The distribution of the winter-vegetable industry is controlled largely by the ability of the various plants to withstand cold. On the Atlantic coastal plain only the hardiest will grow as far north as Norfolk. Central and northern Florida, with near-by parts of Georgia and South Carolina, is our leading winter-vegetable region, contributing a third of the national supply. The large area of suitable soil; variation in latitude, which makes a succession of crops possible, each district being 2 or 3 weeks ahead of the one to its north; and nearness to rapid, cheap transportation into the industrial markets of the Northeast account for this importance.

The earliest winter crop is from the more southern locations in Florida and is grown on light, porous, warm, dry, sandy soils. Such soils return a smaller yield and poorer quality than the better ones, and the vegetables grown on them do not stand transportation as well as those from more fertile soils. In Florida, where

much damage often is done by drought or cold weather, 25 per cent of the truck acreage is irrigated; irrigation also protects the crops from frost to some extent. The various crops tend to localize at certain centers. Thus Hastings, Florida, is noted for potatoes, and Sanford for celery. This specialization occasionally may be caused by soil, but usually it is because the grower of any crop is likely to be more successful if he locates where the production and marketing of the product are already established and organized. This applies especially to marketing.

Florida stands first in the winter crops of tomatoes, snap beans, celery, cucumbers, peppers, and watermelons, and is important for several others.

The Rio Grande area has the advantage of rich alluvial soil, irrigation, and nearness to the Midwestern markets. This district leads the country in the winter crops of cabbage, spinach, onions, and beets. Cabbage is the leading crop, comprising about one third of the total vegetable production. The crop is planted in September and harvested during the late winter and early spring. Other important crops are potatoes, tomatoes, and carrots.

Favorable conditions of soil and climate and facilities for irrigation, important local markets, and the ability to ship some products to eastern markets ahead of other winter-vegetable districts all cause California to be an important grower of winter vegetables. Because of the long distance to the leading markets, there is specialization on the less perishable products that are in most general demand. Coöperative associations watch the quality carefully and have established a high reputation for the products.

There are three vegetable-growing districts in California, the Imperial Valley, the Los Angeles section, and the reclaimed delta lands between Stockton and Sacramento. The Imperial Valley, with its warm winter climate, fertile soil, and irrigation, is the leading district. The state leads the nation in the winter crops of cantaloupes, lettuce, cauliflower, asparagus, carrots, and peas, and is important for cabbage, celery, and tomatoes. Practically the

entire winter crop of cantaloupes and a large part of the lettuce are grown in the Imperial Valley. The other sections supply intermediate crops of these vegetables.

The Salt River Valley in Arizona grows winter lettuce. Scattered districts along the Gulf coast grow various crops, Copiah County in Mississippi being one of the most important. Louisiana is important particularly for winter cabbage and carrots.

The summer-vegetable industry. The value of the summer crop of commercial vegetables is several times that of the winter crop. The summer crop is grown largely in the Northeast in places where soil and economic influences favor it. Soil is important for many of these crops. Thus, asparagus is adapted to salt marshes. Celery grows best in muck, or at least a soil very rich in humus. Cabbage requires a soil rich in humus, but one that is drier and more solid than muck. Vegetable crops are grown largely on sandy soils, however, because of the adaptability of the majority of the crops to such soils, and because other types of crops are not so successful there.

The summer crop is widely scattered throughout the Northeast, because of the wide distribution of areas with the proper natural requirements and because of the near-by industrial markets. The industry does, however, localize itself around certain areas (Fig. 6). Probably the most important vegetable region of the world extends from New York City to Norfolk. Because of its importance, a separate section will be devoted to it. A second district is the lake plain in New York and Ohio, while a third surrounds the lower end of Lake Michigan with southward extensions into central Indiana and eastern Illinois. Small centers are found in New England, around Cincinnati, in the southwestern Ozarks, in several places in the upper Mississippi Valley, in Texas, and in California.

The New York-Norfolk area. This area has more than 25 per cent of the nation's acreage and produces about 20 per cent of the commercial vegetable crop. Its advantage lies in its equable climate, sandy soils, and nearness to market. The indented coast

and frequent winds from the ocean stabilize the temperature and lengthen the growing season. Trenton has a growing season of 170 days, and Norfolk 225 days, the same as Augusta, Georgia.

Since sandy soils warm earlier in the spring than do other types, the growing season is lengthened. Such soils are well drained and easily cultivated and kept clean. They are poor in fertility, however, lacking chiefly nitrogen, and must be fertilized heavily. An

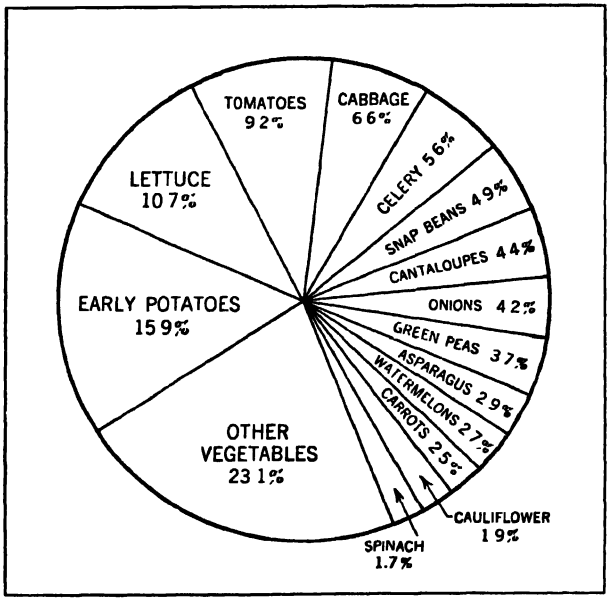


Fig. 73. Relative farm values of the principal commercial truck crops of the United States in 1936.

average of about $10 per acre is spent for fertilizer. There are a great variety of highly differentiated soils in the coastal plain. They are special-purpose soils, adapted to crops requiring intensive and expensive methods. The presence of several types of soil on the same farm increases the farmer's problem in selecting crops for his farm.

The large cities of the area, together with the excellent transportation by water, rail, and highway provide adequate markets. The nearness of the district to sources of fertilizer is also important.

Leading vegetables. The value of the principal vegetable crops is given in Figure 73.

The production of several of our staple vegetable crops will now be described in order to show in more detail just how the various geographic and economic influences exercise their control.

POTATOES

Qualities. Potatoes are the most productive in food value per acre of any plant that can be grown in a cool climate. Since they do not make a complete diet, they must be supplemented by either meat, fish, legumes, or butter and milk, with which they form a complete diet. Potatoes are nearly equal to wheat in food qualities, but they are about 60 per cent water and one must eat four times the quantity to obtain an equal amount of nourishment. One hundred bushels of potatoes have slightly less calories than 27 bushels of corn and about the same amount as 24 bushels of wheat. They have only half as much protein as corn and two thirds that of wheat.

Potatoes are the most widely distributed crop in the United States. This is because they are a hardy, short-season crop of a bulky nature, with varieties adapted to different conditions. Their widespread use and high yield also cause them to be grown widely. Accessibility to market is the chief factor in locating the various producing areas.

Geographic requirements. To be at their best, potatoes require a cool, moist climate with uniform temperatures and moderate rainfall, and a friable, well-drained soil. They do not like lime soils. More than 50 inches of rainfall, especially if accompanied by high temperatures, causes diseases to develop. For this reason successful potato growing is almost impossible in the South, except for the winter crop. Potatoes will mature better in a cool region than any other crop except barley and timothy, and there is no other intertilled crop that will mature in as cool a region.

Regions of production. Maine usually grows about 12 per cent of the summer crop of potatoes, followed by Michigan, Minnesota,

and New York, each supplying about 9 per cent. Wisconsin, Pennsylvania, Idaho, and Colorado are also important.

North Carolina produces about 25 per cent of the early crop, and Oklahoma, Texas, South Carolina, Tennessee, and Florida each about 10 per cent. There is an intermediate crop, of which Virginia supplies almost 40 per cent.

The acreage in the famous Aroostook district of Maine has ranged around 170,000 acres recently and is much less than that of either Wisconsin, Michigan, or Minnesota, but the production is greater. Soil and climate combine to produce a high yield and a superior quality. The high quality, with the resulting higher price, gives these potatoes a wider marketing range than that of only ordinary quality. The chief use of Maine potatoes is to supply the great eastern markets; they are the most convenient source of supply for late autumn and winter potatoes for the urban area from Boston to Baltimore. In addition, they support a small starch industry and are used for seed in many other parts of the country and even in Argentina. Being native to a cool, moist climate, the potato deteriorates rapidly in quality when grown in warmer regions for a few years. The best results are obtained in such places by always planting seed from the cooler districts.

SWEET POTATOES

Sweet potatoes, our second-ranking truck crop, are grown principally in the Southern States and to some extent in the sandy areas adjacent to the industrial centers. They compare favorably with potatoes in food value. They have less protein but more sugar, about 27 per cent toward the end of the storage season, and are a good source of some vitamins. It has been discovered recently that the dried vines have almost as much feeding value for livestock as alfalfa.

The crop is grown over a wide range, but being a native of the tropics, it does best where there is a growing season of at least 175 days and where the mean summer temperature is above 72°. The difficulty of storing in cold weather probably accounts for the

little importance of the crop outside of the South. The great bulk and low value of sweet potatoes doubtless prevent the South's growing more and shipping them to other sections of the country. Nor has their value for food been appreciated fully outside of the South. Recently, however, they have been receiving more recognition in this respect, and their consumption is increasing in the Northern States.

Sweet potatoes will return more food per acre than potatoes. They will also yield more on poorer soil, with less care and less fertilizer. Their running habit is a factor in keeping down weeds and lessening the requirements for cultivation.

The acreage in sweet potatoes averages about 25 per cent, and the farm value of the crop about 20 per cent, of that for potatoes. North Carolina, Georgia, and Alabama each supplies about 10 per cent of the total crop; and Tennessee, Mississippi, and Louisiana each about 8 per cent. The sweet potatoes of New Jersey and Virginia are esteemed for their high quality.

As a result of experiments of the United States Department of Agriculture, a factory has been built recently at Laurel, Mississippi, to make starch from sweet potatoes for sizing textiles, and for an adhesive for stamps and similar purposes. This industry will use the culls, which usually amount to almost one third of the crop. The pulp that remains after the extraction of the starch can be used as animal feed.

The yam, resembling the sweet potato, but inferior to it for food and growing only in warm regions, is produced in some parts of the South. Its roots may attain a length of 30 inches and a weight of 100 pounds.

BEANS AND PEAS

Beans and peas require about the same type of climate as potatoes. Weevils and diseases discourage their production in the warmer regions. Cowpeas, however, are grown in the Southern States. There are three classes of beans: field beans, frijoles, and lima beans; and two classes of peas: field peas and cowpeas.

The production of beans is found in several widely separated but specialized centers. The location of these centers is determined by the soil, the lack of insects, conditions conducive to the use of machinery, the competition of other crops, especially corn, for the land. Grown on a variety of soils, beans do best on a moderately fertile limestone soil. In places they are grown in a rotation with wheat and clover, and in some places they replace corn.

The chief centers for field beans are in western New York along the middle section of Lake Ontario, in central and eastern Michigan in the region of Saginaw Bay,[1] and in the irrigated sections from the North Platte Valley of Nebraska to California. Both white beans and red kidney beans are grown. Frijoles, chief of which are Pintos, are grown in the cool semiarid uplands of central and northeastern New Mexico and eastern Colorado. They are grown both with and without irrigation. The production of these native Indian beans has expanded considerably during recent years.

California grows both field and lima beans, producing the bulk of the latter for the country. The field beans are grown in the Central Valley, east of San Francisco, and along the southern coast. The lima beans are nearly all grown in a narrow belt in southern California within reach of the ocean fogs. Because the rainfall in this area is only 10 or 15 inches, the fog helps to make up the deficiency of moisture.

Field peas, the split peas of commerce, are grown widely, and are increasing in importance in the West, but at present the greater part of the crop is from the Door Peninsula and northern Michigan. They are grown chiefly for grain for livestock, but are also used for hay and ensilage and for human food.

Cowpeas are important only in the cotton-growing areas of the southern Piedmont, where they are used for stock feed and are plowed under for green manure. While they do best on a limestone soil, they do better than clover on the poor sandy soils of the Southeast.

[1] This region also produces nearly all of the chicory grown in the United States. The plant is similar to the parsnip and may be eaten similarly. Our production is all used for blending with coffee.

THE SOYBEAN

Importance. The soybean, a native legume of China, has risen to prominence recently in the United States. It was introduced into this country more than a century ago, but never received much attention, except locally for forage and soil-building purposes, until the time of the World War, when vegetable oils, rubber, and material for plastics became scarce. Production was encouraged after the War by the development of the soybean milling industry. In 1938 about 3 million acres, with a product valued at about $43,000,000, were harvested for the beans. Drought, economic depression, and science all have had a part in the recent rapid expansion of acreage. More than 90 per cent of the crop is grown in the corn belt. Illinois contributes almost 60 per cent of the supply and is followed by Indiana, Iowa, and Ohio. North Carolina, the leading state outside of the corn belt, is fifth.

In China the plant has become a mainstay because it is not injured as much as other crops by drought or flood; the recent series of droughts in the Midwest has very likely been a factor in the expansion of acreage there.

Recently the market for several agricultural staples has been depressed because of oversupply at profitable prices. For many of these food products the demand is relatively constant because man's appetite becomes satiated. People concerned with the welfare of agriculture and of the farmer have been interested in finding some crop for which the demand would not be limited by the appetites of man, one whose demand would be limited only by the ability of man to develop industrial uses for it. The soybean seems to meet this requirement of a crop which the farmer can sell directly to the manufacturer. Technicians already have developed about 1,000 different uses for it. In addition to its commercial value, it is a soil builder for the farmer.

Soybeans have a high content of both protein and oil or fat, 1 pound having the nutritive value of more than 2 pounds of beefsteak or of over a half gallon of milk. The protein content ranges

from 32 to 40 per cent in most varieties. Some special ones have more. In China as the number of animals declined, this bean replaced animal products in the diet.

Natural requirements. The soybean will grow under widely varying natural conditions. The different varieties have become adapted to local conditions, however, and are therefore sensitive to changes in either climate or soil. About 40 different varieties are grown in the United States. The variety grown depends upon the use that is to be made of the crop.

Uses. The vines and the beans both may be fed to animals, and the beans may be prepared for human use in the same manner as other vegetables; but of most interest here are the various industrial uses. Soybean oil and soybean meal are the basic products which result from manufacture, the meal comprising 80 per cent of the total weight. Not only has the meal a high fertilizing value; it is the equal of linseed and cottonseed meal for feeding animals. All farm animals like it, and it seems to have an excellent effect on them. Commercial dog and rabbit foods contain it. Other uses are for adhesives for veneer and insulating material, vegetable casein, water paints, health foods, and malted milk.

The oil is a semidrying one with about the same resistance to weathering and light as other vegetable oils. Its leading uses in the order of their importance are as an ingredient in cooking oils, in paints and varnishes, in soaps and cleansing compounds, and in linoleum and oilcloth. It is also used in making printing inks, disinfectants, lubricating compounds, rubber substitutes, patent and artificial leather, and in foundry cores and as a rust-proofing fluid for castings.

The use of soybeans for making plastics seems to have a promising future. Either the oil or the oil and meal mixed may be used. The resulting products are very strong and are virtually fireproof when combined with certain substances. They enter into the manufacture of billiard balls, radio accessories, buttons, and doll and toy compositions; but most important is their manufacture into steering wheels, instrument boards, and other auto-

mobile parts and accessories. The Ford Motor Company has so much faith in these plastics that it has built a processing plant costing $5,000,000 at River Rouge, and has a large area near by planted to the crop.

The beans are also made into flour, and bakers are now using as much as 20 per cent soybean flour in bread and cake doughs.

II

FRUIT CROPS

Importance and use of fruits. Like vegetables, fruits have become in recent years an important item in our diet. The volume of fruit production in the United States now ranges from 20 to 30 per cent greater than it did fifteen years ago. Fruits serve somewhat the same purpose as vegetables in our diet. They add variety and roughage, have a beneficial effect on health, and serve as appetizers. Citrus fruits are the most important group for the health-giving effects. Because of their vitamins they help to prevent scurvy, maintain sound teeth, and promote growth in children, and help to prevent or overcome malnutrition. The fruit sugar in oranges is easily assimilated, and for this reason athletes often use orange juice as a restorative. Orange juice also is important for infants in providing the vitamins that are lost in the pasteurization of milk.

Types of fruit. Fruits of the United States may be classified as middle-latitude tree fruits, tropical fruits, vine fruits, and bush fruits. Apples, peaches, apricots, pears, cherries, and plums are examples of middle-latitude tree fruits, and oranges, lemons, and grapefruit of tropical fruits. There are several classes of bush fruits. One is those which spread their vines over the ground, as strawberries; another is bramble fruits like the blackberry and the raspberry; and another the bush fruits such as gooseberries and currants. The grape is the best example of vine fruits. There are three types: the bunch grapes of our Northeastern States, the muscadines of the South, and the viniferous type of California.

Natural requirements. As a rule important fruit-growing centers are in places with protected climates. They may be in warm,

subtropical regions, on hillslopes, on the leeward sides of lakes, and in valleys surrounded by high mountains and otherwise protected. The many locations of this nature and the difficulty of transporting fruits have caused fruit industries to arise around the different centers of population, where it is difficult for other crops to compete. Within given large areas where the climate is favorable for fruit raising, biologic and economic influences control the

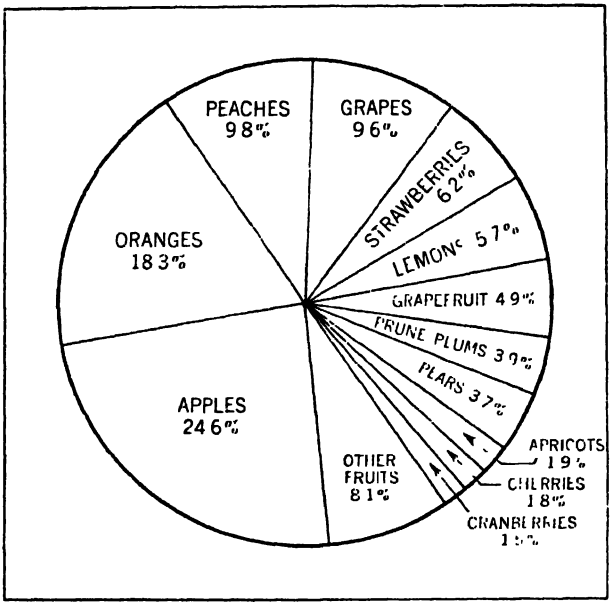


Fig. 74. Relative farm values of the principal commercial fruit crops of the United States in 1936.

exact location of producing centers. Many trees have a wider growing range than their blossoming habit will permit. Thus the peach becomes subject to frost because it blooms earlier than does the apple in the same locality. The peach tree also winter kills readily.

Mountain slopes and foothills are good places for fruit trees because of soil and frost drainage. The cold heavy air moves down the slopes into the valley floor, causing blankets of warmer air to strike the slopes. At times this line is sharply drawn. Cases are

on record in which the lower branches of a tree were frosted while the upper ones escaped. In the case of cranberries a few feet of difference in elevation are important. The fruit at the upper edge of some orchards ripens a few days before that of the lower edge. A case is recorded in California of two stations of 825 and 1,975 feet in elevation, where for 42 nights the temperature at the higher one averaged 15° warmer than at the lower. Trees are often grown on rough lands because they cannot ordinarily compete with other crops for better lands, and usually the other crops could not be grown successfully in the rougher areas.

The leeward sides of bodies of water also give protection from frost. Because water heats and cools less rapidly than land, the winds carry the relatively cool temperatures from the water to the land in the spring. This usually prevents fruit trees from budding until the danger of frost is past. In the autumn first frosts are generally later because of the warming influence of the water.

Soil, too, has considerable effect on fruits. A deep soil, well drained, and with a deep, friable subsoil, is usually best. The loess soils in the Missouri River Valley at the adjoining corners of Kansas, Nebraska, Missouri, and Iowa have helped make that area a fruit section. For citrus fruit the physical condition of the soil is more important than its chemical nature. Good water drainage is necessary, and in California this is found on the alluvial piedmont slopes.

Natural conditions in California. Because California is our leading fruit state, it may be interesting to know how natural conditions there have controlled fruit growing. The climate is controlled by several factors. The great north-south extent of the state places areas in both the middle latitudes and the subtropics, while the rugged topography gives rise to a wide range of temperatures because of differences in altitude. The high mountains to the north and the east provide protection against most of the cold waves that sweep down across the plains region. The Coast Ranges shut off the rainfall from the Central Valley, making its climate hot and dry and sunny. These conditions make irrigation

necessary for most crops but give the fruits a desirable color and provide ideal conditions for their drying. The dry conditions are important in controlling fungus diseases and have been an important factor in the shift of the production of some fruits from the East to California. The westerly winds from the ocean have a tempering influence over most of the state.

The rugged relief also causes different classes of soil. The Central Valley is a plain of connected alluvial fans. Their porous nature makes them a good soil for trees and vines, and also a good reservoir for collecting the water brought down by streams fed by the rains and snows of the High Sierras.

California has more than one sixth of the fruit and nut tree acreage of the nation and normally contributes more than one third the total value of such products. The following quotation shows the scale on which horticulture is conducted in the state. "California ships annually upward of 70,000 carloads of oranges, 15,000 of lemons, 2,500 of asparagus, 29,000 of cantaloupes and other melons, 6,000 of carrots, 6,000 of cauliflower, 8,000 of celery, 50,000 of grapes, 35,000 of lettuce, 10,000 of peaches, 10,000 of pears, and 3,000 carloads of tomatoes, besides substantial quantities of every other fruit and vegetable found on the markets of this country." [1]

Economic factors. Because of the bulky, perishable nature of most fruits, the principal economic factor controlling their production is the location of the markets. Another is the ripening time in one area with respect to others, which accounts for the concentrated areas of peaches and strawberries as one moves northward across the country. The later the blossoming, the more certain, usually, is the crop. The added risk from frost and cold weather causes relatively higher cost for the earlier or more southern crops. Only such quantity can be produced profitably as the market will absorb at a relatively high price before the crop of the next, more northern district is ready to be marketed. The seasonal nature of the work, convenience in obtaining orchard and

[1] United States Department of Agriculture, *Yearbook*, 1935, p. 317.

packing supplies, and coöperative organization in production and marketing are other influences. Coöperative associations, organized on a commodity basis, tend to draw the production of any given crop to certain centers. This is of great help in solving the problems of production and marketing. Even were there no cooperative associations, it would be better that production concentrate at a given center. A new producer will usually find difficulty in operating if he is isolated. The problems relating to both production and marketing will be much simpler if he locates

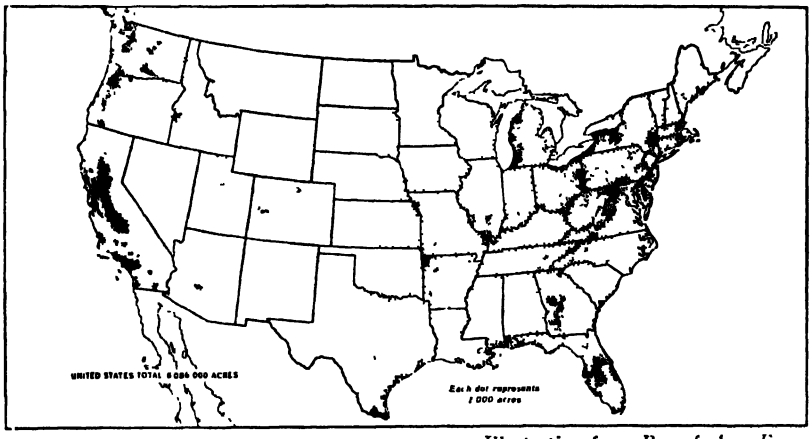


Illustration from Bu of Agr Econ

Fig. 75. Land in fruit orchards, vineyards, and planted nut trees, acreage, 1929

where others are producing the same product. The specialization of canneries also causes concentration on certain products within a given locality.

MIDDLE-LATITUDE TREE FRUITS

General distribution. The important fruits of this group are apples, peaches, apricots, cherries, pears, and plums. All except peaches and apricots are cool-region crops. The northern limit for apples is the winter isotherm of 13°, and they do not thrive where the summer temperature averages above 80°. This is a little beyond the northern limit for cotton. The corresponding northern limit for peaches is 25°, for cherries 13°, for pears

20°, while plums have about the same temperature limit as apples. Of this group only peaches are important in the South.

The areas in which most of these fruits will grow are so extensive and have such possibilities for expansion that the practical limit to their production is economic rather than geographic. The possible area for apples is about fifty times as great as is needed to meet the demand.

Apples. Apples are more important than all the rest of these fruits combined. The tree is hardy and adapted to a wide range of conditions, and the fruit will store and ship better than most of the other fruits. Because of the wide adaptability of apples, in part due to the great number of varieties, commercial apple centers tend to spring up wherever there is a market of considerable size. Two thirds of the crop is commercial, that is, it is marketed, rather than used on the farm where it is grown.

Washington is the leading state, with 18 per cent of the total and 25 per cent of the commercial production. New York follows with 14 and 12 per cent, and then the Appalachian section of Virginia and northeastern West Virginia with 10 per cent of the total crop and 9 per cent of the commercial crop. The latter section, however, has 14 per cent of the total number of apple trees, New York 11 per cent, and Washington only 8 per cent.

High freight rates from the West are a handicap that must be overcome if the Pacific Northwest is to meet the competition of the eastern centers. The fertile soil, irrigation, and the great amount of sunshine, which gives a good color to the fruit and retards the attacks of diseases and insects, combine to produce a high quality. These factors in connection with the efficient methods of marketing employed have made it possible for western apples to compete in some degree with those of the East. Western apples also are important in the export trade because their rich color makes them highly desirable in European markets.

Peaches. There are five important centers of peach production, namely (1) the Central Valley of California, (2) Central Georgia, (3) the southwestern Ozarks, (4) southern New Jersey, and (5)

the Lake Ontario section of New York (Fig. 75). California, with Fresno being the principal center, normally produces nearly 50 per cent of the total crop. The production results entirely from irrigation. The peaches are usually canned or dried, the state contributing nearly all of the national output of canned peaches. The early Georgia crop is nearly all shipped fresh, the state leading the country in this respect. New York and New Jersey supply the late crops. Growing centers which have lately become prominent are the sandhill section of North Carolina, the southwestern Ozarks, and southern Illinois, all of them supplying the intermediate or late markets.

Apricots. Apricots are the most sensitive to frost of any of this group, and, consequently, their production is limited nearly altogether to California. Some are shipped fresh, but the bulk of the crop is canned or dried.

Cherries. There are both sweet and sour cherries; the former are confined largely to California and Oregon, because moist weather in the East at ripening causes disease to attack them. The sour-cherry area coincides with the corn belt, with northward extensions because of the influence of the Great Lakes. New York and Michigan are the leading commercial producers. Some cherries are marketed fresh, but most of the crop is canned.

Pears. The leading centers of pear production are the Central Valley of California near San Francisco, the orcharding sections of Oregon and Washington, the southern shore of Lake Ontario, the Hudson Valley, and western Michigan. The Pacific Coast States grow about two thirds of the entire crop, with about half of the production coming from California. The pear industry has moved to the West because of the inability of the trees to withstand the pear blight, which attacks it in the East. There are some blight-resistant strains, but the fruit lacks flavor. Although pears are to some extent marketed fresh, they start to deteriorate quickly after ripening, and, consequently, most of the crop is canned.

Plums. Plums are unimportant except along the Pacific coast, where most of the production is used for prunes. The prune

plum, however, is a different variety from the plum of the East. California has more than half of the nation's acreage of plums, the industry centering around San Francisco in the Central Valley and other valleys, chiefly the Santa Clara Valley. The Willamette Valley in Oregon is also an important district. Though plums are scattered widely throughout the East, the only important commercial district is just above Buffalo on the south shore of Lake Ontario. Wild plums are plentiful in many parts of the East.

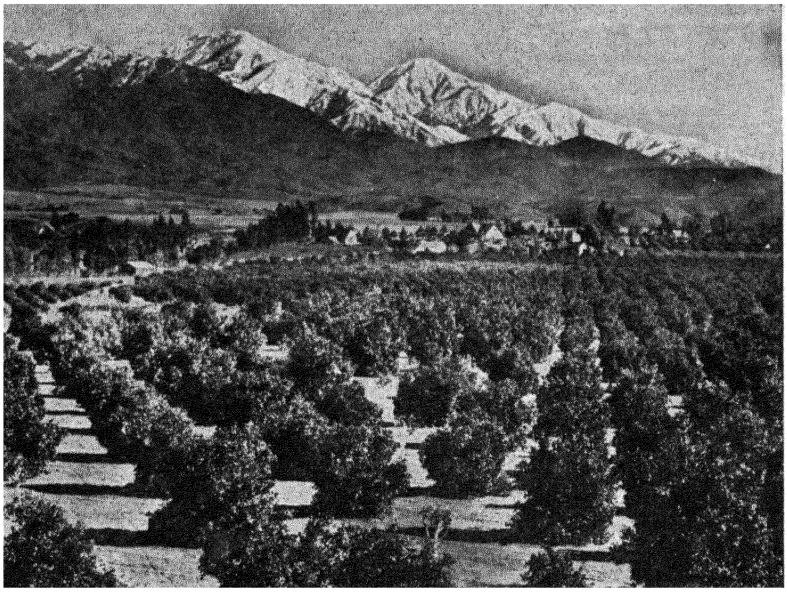
The United States leads the world in the growing and exporting of prunes. The greater part of the crop is dried, but some of the plums are canned and from some the juice is extracted and canned. About one third of the crop is exported, 80 per cent of the exports going to Europe. Germany is the leading market, followed by the United Kingdom.

CITRUS FRUITS

Importance. The principal commercial citrus fruits are oranges, lemons, grapefruit, and limes. The latter are unimportant, however, because of their exacting temperature requirements.

Location. Citrus fruits are important in California, Florida, and the lower part of the Rio Grande Valley. An extensive acreage, chiefly of the Satsuma variety of oranges, has been planted along the Gulf coast from Florida to Texas; and there is some concentration on round oranges in Arizona and southeastern Louisiana. The Satsuma variety is hardy, seedless, and sweet. Its early maturing is an advantage which places it on the market before the heavy movement starts from Florida. Each area has characteristics peculiar to it. Florida is warmer on the average through the winter than California but is more subject to occasional cold waves. In the lower Rio Grande Valley, freezing is less frequent than in either Florida or California, but the temperature occasionally goes lower. California probably suffers less frost injury than the others because of the uniformity of the cool weather.

California has about 20 million citrus trees, principally on the alluvial fans and piedmont slopes in the valley between Los Angeles and Redlands, the latter being the most important shipping point. Lemons are grown chiefly on the foothills of the western side of the Coast Range. The fruits are grown largely under irrigation from water that is pumped; the trees must be watered once a month for six months each year. Two types of oranges are



Courtesy Union Pacific Railroad Co. Photo by Putnam Studios.
Fig. 76. Orange groves and snowy peaks near Los Angeles.

grown, the navel and the Valencia. The navel is marketed during the winter and spring, and the Valencia during the summer and fall, the latter bringing much the better price because it lacks serious competition from other regions during its marketing season and because it is more popular with consumers. Neither do all oranges of this variety ripen at one time, those planted near the coast ripening later than those in the interior. Owing to the increased popularity of orange juice, the Valencia has increased in favor during the past two decades and now is 50 per cent more

important in quantity than the navel variety. The plantings of the Valencia increased 25 per cent from 1927 to 1934.

The 18 million citrus trees of Florida are largely on the gently sloping lands of the lake district in the central part of the state. Grapefruit are more important in the southern part of this area. Orange growing was established first in the northern part of the state, but the severe winter of 1894-95 ruined the industry there and caused it to move farther south, where frost danger is less. The fruits are grown without irrigation. In Florida conditions are somewhat similar to those of the native home of the orange in southeastern Asia.

Coöperative marketing has not attained the importance in Florida that it has in the West Coast States. In California the oranges are often picked by crews of specialists, the farmer's only duty being to cultivate and irrigate them. After being picked they are taken to packing sheds, where polishing, dipping in wax, grading, and packing take place. In many cases the packers wear gloves so as not to bruise the fruit with their fingernails.

The lower Rio Grande Valley is our newest citrus fruit district, and fruits may become its chief money crop. The trees are grown under irrigation on rich alluvial, almost level lands. This valley also has the advantage of Mississippi Valley markets. The district is specializing in grapefruit because it can grow fruit of excellent quality, owing, supposedly, to the soil. Texas grapefruit has a better flavor than the Florida and California varieties. The oranges grown here, chiefly of the round variety, have a poor flavor.

The United States recently has had an average annual production of about 54 million boxes of oranges, 18 million boxes of grapefruit, and 8 million boxes of lemons. Almost the entire crop of lemons and two thirds of the oranges are grown in California, which also has a small crop of grapefruit. Florida grows 60 per cent of the grapefruit and nearly one third of the oranges. Texas supplies about 30 per cent of the grapefruit; the other Gulf States and Arizona have small crops of oranges, and some of them

small quantities of grapefruit. Florida grows almost all of the 8,000 boxes of limes in the extreme southern end of the state. The industry has declined markedly during the past decade but may expand again with the introduction of the Tahiti, a new seedless variety which is being planted as a substitute for lemons.

The average production of oranges has been three times that of grapefruit, but the value has been five times as much; lemons, with production less than half as large, are almost equal in value to grapefruit.

The United States Department of Agriculture recently has estimated that over the next several years the orange crop should average slightly greater than at present, while that of grapefruit is likely to increase 50 per cent or more and lemons from 25 to 30 per cent. This is the result of new plantings which will come into bearing during this period, and of the greater productivity of trees which have begun bearing only recently.

About 6 per cent of our oranges and 5 per cent of the grapefruit are exported. Half of the grapefruit is sold to the United Kingdom and more than half of the oranges to Canada and most of the remainder to Great Britain.

OTHER TROPICAL FRUITS

The olive, date, fig, and avocado are minor tropical fruits of the dry Southwest, for which, it is thought, there are great future possibilities. The avocado is grown also in Florida. Though the olive is not strictly a fruit, its uses are such as to justify discussion here.

The olive is native to the Mediterranean region. It cannot withstand severe freezing but possesses a leaf and a root system that make it drought resistant and better adapted to the dry subtropical type of climate than any other fruit. Although some oil of high quality is produced, most of the crop of this country, which ripens in late autumn, is pickled green, either whole or, after removal of the seed, stuffed with pimento. California is the foremost olive-producing state, although the Salt River Valley in Arizona has

also achieved prominence. Most of the orchards of California are along the foothills of the southern part of the state; there are some in the San Joaquin Valley and near San Francisco.

The date, which is claimed to be more nutritious than beefsteak, has only recently become of commercial importance. The tree is able to withstand temperatures as low as 15°, but the fruit is easily injured by rain, some varieties even being injured by dew or excessive humidity at ripening time. A tree produces from 10 to 30 clusters of fruit annually, each cluster weighing from 20 to 25 pounds. In the United States about 200 pounds is the maximum production for a tree. The date tree grows successfully in this country only in the hot irrigated valleys of the Southwest, the greatest area now being in the Coachella Valley. Trees have been set in large numbers also in the Salt River Valley, the Imperial Valley, and near Yuma. The expansion of the date industry has been retarded by the high price of trees for setting orchards. Superior trees can be started only from shoots from the bottoms of older trees, these selling at from 10 to 25 dollars each. About 50 are set per acre.

The fig tree is hardier than citrus trees or the date palm and thrives in most parts of the southern United States. Its fruit is almost equal to the date in food value. Development of fig growing was retarded in the United States because the habits of the tree were not at first understood. The blossoms of the variety grown in California are fertilized by a female wasp that crawls inside covered with pollen from the wild fig tree, and the wasp is absorbed by the blossom. Both the wild fig and wasps had to be brought from Asia Minor, and it took time to acclimate the wasp. One wild tree is sufficient to pollenize 100 of the other trees. Often twigs of the wild tree are clipped and hung on the fruit-bearing trees. The fruit ripens about the first of August.

Figs are grown widely over the warmer parts of the United States, but the varieties are not always the same in different localities. The southern part of California is the leading section. The

area around Houston, Texas, produces large quantities, which are nearly all canned. The Carolinas at one time had an important industry, but cold weather gave it a setback. Over a great part of the Southeast fresh figs are eaten either raw or cooked.

The avocado, the fruit of a tree that is native to Mexico and Central America having the same natural requirements as the orange or lemon tree, has been consumed but little until recently because of high price. Larger imports and the setting of orchards in California and Florida, the former now having 8,000 acres in the trees and the latter 2,500, have resulted in a lower price and a much greater demand. More than 20 million pounds are now consumed annually. This fruit contains no starch, less than one per cent of sugar, some protein and minerals, and from 7 to 26 per cent of oil of a composition similar to that of olive oil; it is a good source of several of the vitamins.

There are many varieties of the avocado of various colors and shapes, ranging from 6 ounces to 3 pounds in weight. The most popular varieties are greenish in color and weigh from a half to one pound. The quality of the fruit depends on the maturity when harvested and on the oil content. It is usually eaten fresh, since cooking injures the flavor.

In this country the crop is grown and marketed by coöperative methods. Constant care to protect it against disease and insects is necessary. According to the United States Department of Agriculture from 75 to 100 dollars per acre is required annually to maintain an orchard in good condition in Florida. Care must also be exercised to harvest the fruit at the proper stage and to prevent bruising in harvesting. A tree will bear from 3 to 5 crates a year. The crop from California is marketed during the winter and spring, that from Florida during the summer and autumn.

GRAPES

Types and location. Grapes are a moderately hardy fruit and, like apples, are produced widely over the country; but their com-

mercial production is highly concentrated around a small number of centers. At present California has about 75 per cent of the acreage and 90 per cent of the production of the country, with an investment of one third of a billion dollars in the industry. The grapes there are of the viniferous type and were brought by the early monks from Spain. The main district is in the Central Valley from Fresno to Sacramento. Another is the region just north of San Francisco Bay, and a third at San Bernardino. Fresno, where the land is flat and the sunshine almost continuous, is the center of the raisin industry, practically the whole of the nation's production being prepared there. The United States outranks all other countries in the production of raisins with an annual output valued at 10 to 12 million dollars. From a quarter to more than one third of the output is usually exported, two thirds going to Europe, mainly to Great Britain and Germany, and a quarter to Canada. Several different varieties of raisins are produced.

In southern California and in the Sacramento Valley and the area north of San Francisco, chiefly table and wine grapes are grown. About 40 per cent of the total crop is wine grapes, 33 per cent raisin grapes, and the remainder table grapes.

The native grapes of the Northeast are chiefly consumed fresh or are made into grape juice. They do not keep well, nor do they have a solid enough pulp or enough sugar to make good raisins. There are three centers of production. The main one is a belt a few miles wide between Toledo and Buffalo, with the greatest intensity between Ashtabula and Buffalo, especially in Chautauqua County, New York. The second area is around Ithaca in the Finger Lakes district, and the third in the extreme southwestern corner of Michigan. Minor areas are found in the Hudson Valley, in the Ozarks, in western North Carolina, and in Washington and Oregon.

The muscadine grape is of increasing importance in the South Atlantic and Gulf States. Grapes are not usually successful in hot moist regions because of the attacks of fungus diseases.

BUSH FRUITS

Influences controlling production. The conditions under which bush fruits grow are nearly the same as for vegetables, and for the same reasons. The strawberry industry, with its winter, spring, and summer crops, resembles the potato industry in its organization. The others are summer industries. Bush fruits, though usually hardy for years, are often damaged by late frosts.



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Fig. 77. Dewberry fields in sandhill district, North Carolina.

All of them, except currants and gooseberries, which bear for years, send up new shoots each year. All do best on a sandy soil, the more fertile soils causing a heavier growth of the plant and less fruit.

Bush fruits are grown largely in the cool sections of the country near markets and where topographic conditions provide protection against frost. They vary, however, in their requirements. Raspberries, currants, and gooseberries are natives of cool climates. Blackberries and dewberries withstand more heat than the others, but high temperatures are damaging to all, and none of them will

tolerate drought. The dewberry has a long taproot, which enables it to grow better in poor sandy soils than the others.

Blueberries and cranberries are more exacting in their requirements than the others. Both require an acid condition of the soil, a characteristic of low-lying, moist soils with a high water table. Blueberries, a product of wild or semiwild conditions, require the higher water table. Cranberries are grown largely in wet peat bogs which were considered worthless before the industry was established.

Uses of bush fruits. Bush fruits are eaten fresh, frozen, as preserves and jellies, and as canned fruit. They are best when fresh, for they lose their qualities somewhat when prepared in other ways. The recently discovered quick-freezing process, however, offers a method of storing them for relatively long periods without the loss of the qualities of fresh fruit. About 80 per cent of our commercial fruit preserves are of strawberries and raspberries, two thirds being of the former. The chief use of strawberries, raspberries, blackberries, and dewberries is for fresh dessert. They are also important in the ice cream trade. Cranberries, currants, and gooseberries go largely into preserves, jellies, and marmalades. Some are canned, some made into wine.

Centers of production. Bush fruits are grown along the Pacific coast and throughout the northeastern third of the nation. There are relatively few centers, however, that are commercially important. The Cape Cod area is famous for its cranberries, producing almost two thirds of the crop of the United States, and near-by districts grow strawberries. The Finger Lakes and Lake Ontario area is the chief producer of bush fruits other than strawberries, while the eastern shore of Lake Michigan grows all types. Hammonton, New Jersey, is an important raspberry and blackberry center, while all of southern New Jersey and most of the peninsula between Delaware and Chesapeake Bays are important strawberry districts. New Jersey also produces about half as many cranberries as Massachusetts. Southeastern North Carolina is important for strawberries and dewberries. Sanford, North Caro-

lina, claims to be the largest dewberry market in the world. The strawberry area, which is east of the dewberry district, is one of the leading shippers of fresh berries. Louisiana, chiefly in Tangipahoa Parish, produces about 12 per cent of the entire strawberry crop of the nation. Other important centers are near Tampa, in northwestern Tennessee, and the southwestern Ozarks. California produces about two thirds as many as Louisiana. On the west coast, the Los Angeles and San Francisco areas and the Willamette-Puget Sound lowland are the principal centers for bush fruits, each district growing the various types. The Northwest is an important canning center for these fruits, especially for loganberries and raspberries. These berries are more perishable than strawberries and hence cannot be shipped fresh for as long distances. Some cranberries are also grown in the Northwest. Maine is the leading blueberry producer.

SUMMARY

The home orchard. At one time in the United States, the home orchard and small plots of grapes and bush fruits were important in providing considerable extra income for farmers. This was especially true of apple orchards. There are several reasons for the decline of this home fruit growing. First, farming has become more commercialized and specialized, and the farmer does not wish to take time from his main crops. In many places orchards that were killed by unfavorable climatic conditions were not replaced. The farmer also experienced difficulties in growing and marketing fruit in competition with the commercial orchards. He did not follow scientific methods of production in caring for the trees and controlling diseases and insect pests. The quality of the fruit was thus inferior. Neither could he market his small surplus as advantageously as the large orchards could market their product.

Markets for fruit. Fruits normally contribute 10 or 12 per cent of the total agricultural income of the nation. Probably from 25 to 30 per cent of the total production is for home use. A some-

what smaller amount is exported, and the remainder supplies the commercial city markets. Export markets have been increasing, fruits now comprising about 12 per cent of all agricultural exports and 4 per cent of total exports. Dried and canned fruits are each a little more than 1 per cent of the total exports of the nation, and apples a little less than 1 per cent. Ten per cent of the total production of fresh fruit is exported, 40 per cent of the dried fruit, and 20 per cent of the canned fruit. Canada, the United Kingdom, and Germany are normally the leading markets.

The markets for fruit will probably expand only gradually. A smoother functioning of foreign trade relations might increase sales to Europe, but competition is increasing there with other countries. The domestic market will expand with the increase of city populations. A slowly expanding market is best for the industry as it will tend to prevent overexpansion. We may look for annual variations in prices, however, because of variation in climate.

12

NUT CROPS

SOME parts of the world, notably the Mediterranean region, make important use of nut crops for both man and animals, but in the United States the immense possibilities offered by such crops have been neglected. These crops not only can provide food for man and animal, but also can make possible the extension of the production of tree crops into regions with natural conditions that limit successful fruit culture, often providing crops in areas that are fit for little else.

Qualities. Nuts supply chiefly protein, the content ranging from 5 to 20 per cent, and therefore they are good substitutes for animal products; some kinds also contain a considerable amount of either fats or carbohydrates.

> Two Brazil nuts, or five pecans, or ten almonds represent about as much energy food as two slices of white bread or a cup of cooked oatmeal. Pecans, hickory nuts, Brazils, filberts and butternuts all contain a high proportion of fat, the pecan the highest of all. Almonds are rich in calcium, the pistachio heavy with iron—a fact which may account for their inclusion in certain diets. Pecans are generously supplied with copper. Walnuts and peanuts—the latter not strictly nuts but legumes—are said to be acid in their effect; the others, alkaline. Practically all contain a little vitamin A, somewhat more of B, some of G, none of C and D.[1]

It is said that lime is lacking in the American diet and that, in proportion to their weight, nuts supply more of this substance than does any other food.

Problems of nut growing. Keen competition among nut producers for markets, the long period required for the trees to reach full bearing age, and marked long-term fluctuations in prices are

[1] Florence Brobeck, "Fresh Nuts for Holiday Tables," *New York Times*, Nov. 8, 1936, p. 18. Reprinted by permission.

the problems facing a nut-growing industry. Coöperative marketing, the invention of machines for cracking nuts, the rise of small shops in the cities that prepare the shelled nuts in an appetizing manner, and the growth of the confection and ice cream industries have, however, expanded the market for the domestic crops during the last two decades (Fig. 78). Man's appetite, however, is limited; hence the only way to create a market to consume the product of thousands or millions of acres is to use nuts as feed for livestock or to find industrial uses for them. Some nut trees require as much as 40 years to reach full bearing age, and most varieties require several years. As a result the grower's investment is tied up for long periods without any return. Unwilling to wait so long for a return, he grows annual crops instead. As with all tree or perennial crops, the tendency is to overexpand. High prices for an extended period lead to overplanting, to be followed, when the trees reach maturity, by a period of depressed prices, such as has happened in the production of most tree nuts in this country since 1925. Trees may be uprooted and the land planted to some other crop, but the grower will hesitate to destroy his investment, and it may also be difficult to shift to other crops or to change the farm organization.

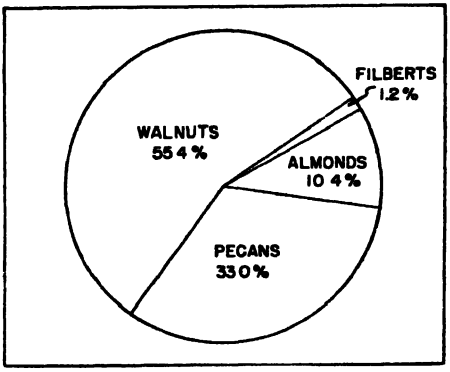


Fig. 78. Relative importance of principal unshelled tree nuts in the United States in quantity produced. Average for 1935-37.

Regions of production. The American climate is said to be well adapted to nut-tree culture, and the number of species makes it possible to grow a crop in any part of the country where trees will grow. Only a few districts, however, are of commercial importance. Production, with the exception of the pecan, is confined largely to the Pacific coast. Some wild nuts are harvested for sale

in the East and the South, and many families gather them for their own use.

Persian walnuts. Persian (English) walnuts are the nuts most widely used for human consumption in this country. The tree cannot stand early or late frosts or sudden changes in temperature, and, consequently, almost the entire crop is grown in California and Oregon. It is possible that hardier varieties may be propagated for growing in the East. The natural requirements of the tree enable it to overlap into both citrus and middle-latitude tree fruit regions. A rapid increase in production has resulted recently from new plantings of improved varieties, better methods of culture, and the increasing maturity of the bearing trees. There are 166,000 acres in the crop at present.

Almonds. The almond tree is similar to the peach tree in both appearance and geographic requirements, except that it adapts itself to soils that are too dry for the peach and most other fruits. Nearly the entire crop is grown in Contra Costa County, California, where there are about 72,000 acres in trees. Almonds are used much in baking.

Pecans. The pecan tree is native to America and has a wide range of growth. Although there are different varieties adapted to varying natural conditions, the tree is commercially important only in the South. Hardier than citrus fruits, pecans do better at altitudes that are too low for middle-latitude tree fruits. They thus fit into the gap between the regions of production of those two types of fruit. Both improved and seedling varieties are grown, the latter accounting for 75 per cent or more of the total crop. The improved varieties usually sell for about double the price of the seedling. Georgia grows about one third of the improved variety, followed by Alabama and Mississippi. The seedling varieties are grown largely west of the Mississippi River. Texas produces about 40 per cent of the national output of both varieties, followed by Oklahoma with about 20 per cent, and then by Georgia, Louisiana, and Mississippi. There are now more than 18,000,000 pecan trees in the United States. The number of trees

of the improved variety is almost equal to the number of seedling trees, but the former type has been set in large numbers only recently and, consequently, the trees have not yet reached full maturity.

Filberts. Filberts of the European type are grown in the Pacific Northwest. They require fertile, well-drained soil. Pruning and interpollination are also important factors. Native varieties, called hazelnuts, grow in the East but are not commercially important.

Pine nuts. Pine nuts are consumed widely, and there are many varieties, differing in size and quality. Most extensively used is the piñon, which has always been important in the diet of the Indians of the dry Southwest, where it grows without irrigation on dry slopes at altitudes of 5,000 to 9,000 feet. It is now shipped from the region in large quantities.

Other nuts. Several other species of nuts are either harvested wild or are being experimented with to determine their possibilities. The black walnut, one of the most desirable of nuts, grows throughout the warmer parts of the East. It is harvested for sale largely in the southern Appalachians, with Baltimore the chief wholesale market. The butternut, or white walnut, grows in cooler locations than the black walnut, either farther north or at higher elevations.

The native chestnut, which formerly went to waste by the millions of bushels, has been all but exterminated by a bark disease or blight. A few commercial orchards remain in the Midwest. The domestic nuts found on the markets are now largely from Wisconsin. It is thought that the industry may be revived by crossing the native with the Oriental chestnut, which is practically immune to the blight. Chestnuts are about 75 per cent carbohydrates. The native variety has a good flavor but is small and hard to hull.

In the arid Southwest, experiments are being conducted with the carob tree, a variety of locust, and the pistachio tree, both from the Mediterranean region. The carob requires the same climate as the orange, but will grow on land that is too dry and rocky

for the orange. Large areas in California are adapted to it, and plantings are now being started in the foothills of the Sierra Nevadas. The crop would be an ideal one for southern California, because it will grow without irrigation, and a supply of water for irrigation is the main limitation there to the expansion of the acreage in other crops. The carob bean is used widely in Europe as a food for animals and to some extent for man. It has a high sugar content, and is used in this country for making syrup for confections and for flavoring tobacco, and in some commercial animal foods. The tree will produce as much as 1,000 nuts per acre annually.

The pistachio has a wide climatic range and will grow in rocky places that are almost devoid of soil. It is said to be the nut taken along for food by the brethren of Joseph when they were driven from the land of Canaan. It is used in the ice cream and confection industries, and for flavoring.

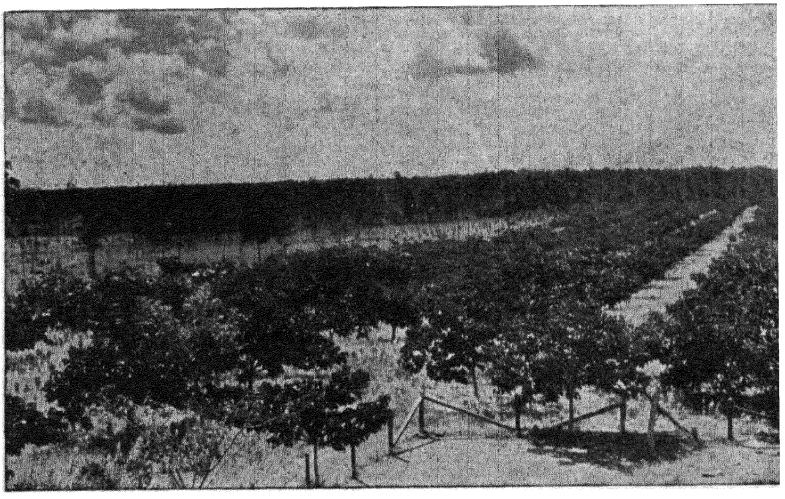
The honey locust, which grows throughout the East, is very productive in beans which have a high sugar content and which make an excellent feed for animals. A tree will produce as much as 20 bushels of beans in a season.

With improved varieties the acorn and hickory nut might be of more use than they now are. Acorns grown in this country are bitter because of the tannin which they contain, but the Indians use them for food, and around the Mediterranean a sweet acorn is an important article of diet.

The tung tree. From the nut of the tung tree, introduced into the United States from China in 1905, is obtained tung-nut oil, the most powerful and the most durable of drying oils. Used in the making of enamels, paints, varnishes, and plastics, and as a material for electrical insulation and waterproofing, it is believed that the domestic market would absorb the output from a million acres of the trees. There are now less than 200,000 acres in tung trees and not all of these have reached a productive age. The majority of the orchards are owned by corporations, but there are possibilities of profitable groves on

small farms, which would thus have an industrial crop to sell. In some districts along the Gulf coast the tree has been introduced to provide income for people inhabiting cut-over timber sections.[2]

The tree is adapted to the climatic conditions that prevail in a belt about 100 miles wide along the Gulf coast as far westward as eastern Texas. The buds are very sensitive to frost. The tree does best on an acid soil with a heavy clay subsoil which is well-drained. From 50 to 60 trees are set per acre and, when



Illinois Central Railroad Co.

Fig. 79. Tung-tree orchard in Mississippi in foreground, pine forest in background.

mature, each tree will produce annually about 100 pounds of nuts from which about 20 pounds of oil is extracted. To do well the trees must have an abundance of plant food. A tree reaches its full productive capacity at about 8 years of age and will continue to bear for 40 or 50 years.

The oil is extracted from the seeds, which are inside a woody pulp the size of an apple. The cake that remains after crushing

[2] For a fuller discussion of this industry see R. L. Parson, "Tung Culture in the Gulf Coast Region," *The Journal of Geography*, 38:337-348.

is injurious to livestock, but it has a value as fertilizer almost equal to that of cottonseed meal; and the outside hull, which is rich in potash, makes a good mulch. Unlike most other vegetable oils, tung oil cannot be used for food.

PEANUTS

Qualities. The peanut (groundnut) is really a legume similar to beans or peas, but is called a nut because of its flavor. It is supposed to have come to the United States by way of Africa on the slave ships, where a compact, nutritive, cheap food product was an advantage. Its nutritive value was not generally known in this country until the time of the Civil War, when the rations of both armies were scarce. The peanut contains 29 per cent protein, 49 per cent fat, and 14 per cent carbohydrate. This is 1½ times as much protein, and 3 times as much fuel value as is contained in an equal amount of beefsteak. While it is a legume, it is not so good for soil building as are some other legumes. In harvesting, care must be used not to pull the roots if one wishes to have the nitrogen remain in the soil. It has been estimated that the fertilizer value ranges from 3 to 8 dollars per acre. The fruit of the plant grows beneath the surface of the soil on a shoot of the female plant which curves downward.

Natural requirements. For most successful production, the peanut plant requires a long growing season and a sandy loam soil with an abundance of lime and a well-drained subsoil. The plant does well, however, under a variety of conditions, and several varieties have been developed as a result, the most important being the Virginian, the Spanish, and the Carolina.

Uses. The most important uses of the peanut are for cattle and hog feed, and for peanut butter, oil, and cake. The use of the oil increased at the time of the World War, when there was a shortage of vegetable and animal fats. It is used chiefly as a packing oil. The oil is extracted largely from unshelled nuts, often poor grades and culls, and has the taste of the soil, which limits its use for food. Peanut cake, which is fed to animals, is

the residue from the oil mills. In the manufacture of peanut butter, the kernels are first roasted, after which the skins are removed with brushes. Two varieties, the Virginian and the Spanish, are blended for this purpose. The by-products of peanut-butter manufacture are sold to soap factories.

In feeding the crop directly to animals the tops are used for forage and the nuts are fed to hogs. Often the hogs are turned into the fields to eat the entire crop of nuts, or they may eat only the nuts that were missed in harvesting. On account of their large proportion of oil, peanuts make a flabby meat, and if a good grade of meat is desired, the hogs have to be finished on grain.

Regions of production. Two important regions growing peanuts may be noted: (1) the Carolina-Virginia district, centering at Suffolk, the world's leading peanut market, and (2) the Georgia-Alabama district of southwestern Georgia and the adjacent part of Alabama. North Carolina and Georgia each produce about a quarter of the crop, Virginia and Alabama each about 16 per cent. The crop of the Suffolk area is used chiefly for human consumption; that of the Georgia-Alabama for feeding hogs, but also some for making peanut butter. In late years peanut production has been expanding rapidly in Texas.

The farms in regions which grow peanuts present a more prosperous appearance than those which grow cotton or tobacco. As stated previously, peanuts restore nitrogen to the soil, and the crop adapts itself to systems of rotation and livestock farming.

As is the case with many other crops, machines have been developed to do the greater part of the work. There is a digging machine that cuts the root off at the proper height, and that also cleans and brushes the nuts. Peanuts are threshed with a machine which will thresh about 600 bushels in a day.

SUMMARY

Outlook for nut crops. The output of nut crops has been expanding, and for tree nuts the outlook is a continued high

level of production for several years, with somewhat lower prices. Since these crops are grown in rather restricted areas, however, it is easy to market them, as the producers have done, by coöperative methods, thereby stabilizing the price. In the case of peanuts



Pan American Union.

Fig. 80. Peanuts stacked for curing.

the crop is an annual, and therefore production can be controlled more easily than can that of the other nut crops. The demand for peanuts has grown because of better methods of preparing them and more aggressive methods of selling, and because of a marked increase in the use of peanut oil (output of late has been about four times the 1925-29 average).

Import trade in tree nuts. The United States imports a considerable amount of tree nuts. Brazil nuts and the cashew nuts from India each comprise about 20 per cent of the total imports, followed by chestnuts, almonds, pistachios, and filberts—all from the Mediterranean countries.

13
SUGAR CROPS

SUGAR is one of the more recent staple articles of diet. It is all carbohydrate and is, therefore, all digestible. It gives flavor to foods that would require other flavoring were the sugar not used. Consumption in the United States has increased from 8 pounds per capita in 1820 to about 100 pounds at present, an amount which provides us with 20 per cent of our total energy requirements. One reason for the large quantity used is the high consumption of confections and ice cream, the per capita use of the latter being about 1½ gallons annually. In but few countries, of late only Australia and Hawaii, does the per capita use of sugar exceed that in the United States.

Sources of sugar. There are many sources of sugar, the two chief ones being sugar cane and the sugar beet. Honey and fruits served the purpose in Biblical days. The sap of the sugar-maple tree served the early colonists, and maple sugar and maple syrup are still important articles of commerce. Sorghum contains some sugar, and corn contains about 25 pounds per bushel. The world obtains its sugar chiefly from sugar cane and the sugar beet because they are more productive in sugar per unit of expense than the others, and because the other sources which might be important have more profitable uses at present; sugar cane and the sugar beet cannot profitably be used for anything else. However, these two plants have been improved through experimentation, and are much more productive than they were a few decades ago, an important factor in the great increase in the consumption of sugar. The cost was lowered so much that sugar could become a staple article of consumption. At the time of Queen

Elizabeth, a pound of sugar was worth as much as a quarter of veal.[1]

THE SUGAR BEET

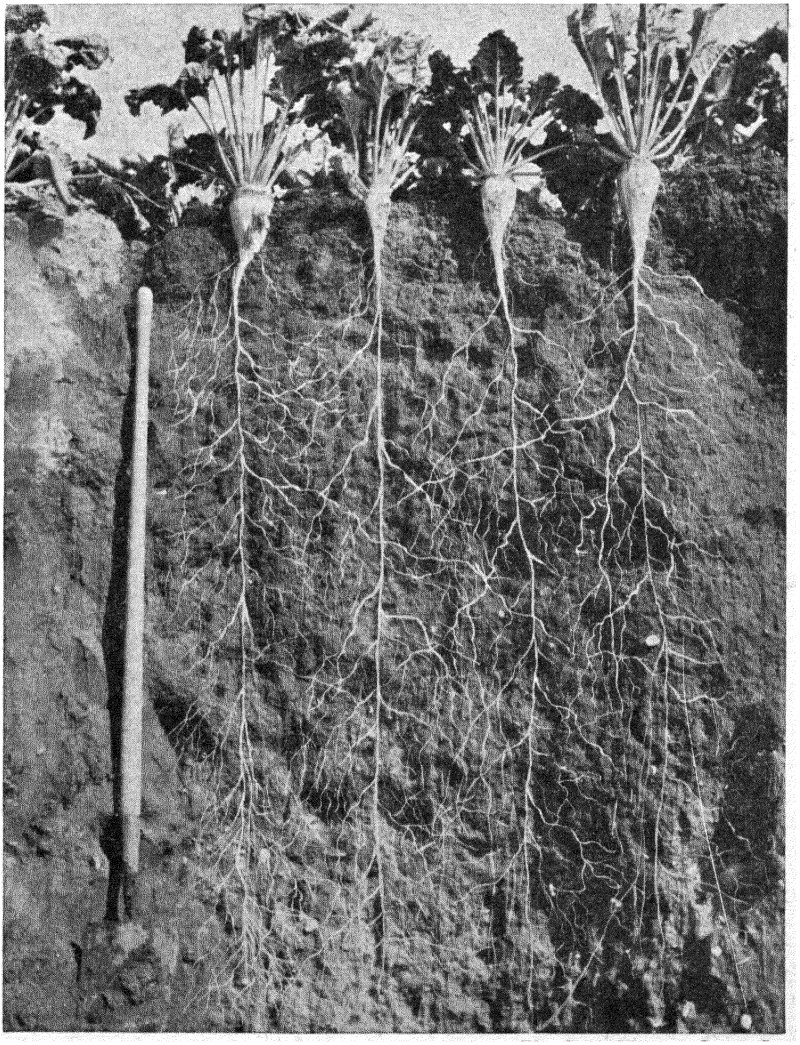
Requirements. The production of sugar in the United States illustrates the competitive difficulties encountered when a crop is grown out of its natural habitat or when cheap labor is required. Were it not for protective tariffs, this country could not compete with the tropics in cane sugar.

Recently, of the 14 billion pounds of sugar consumed annually in this country, from 70 to 75 per cent has been imported. Until lately, the sugar beet has supplied about 90 per cent of the domestic production. Its areas of production are determined by conditions of climate, relief, soil, and labor supply. The plant has a wide climatic range but does best in a cool region, not storing enough sugar to be profitable where the summer temperature averages over 72°. A mean summer temperature of 70° is best. A growing season of 5 months is required, with moderate rainfall, well distributed throughout, but heavier in the early part to make large roots. Drought retards growth, while excessive moisture causes a temporary decline in the sugar content. A dry autumn, with cool nights and marked variations in temperature from day to night, is necessary for the storage of a high amount of sugar in the root and is an advantage for harvesting. The plant is very sensitive to frost when young but can stand considerable cold when maturing.

Soil is important for sugar beets, deep, friable, well-drained and well-aerated types being necessary for the roots to expand. Considerable lime and an abundance of plant food are required. The best results are on dark-colored silt and loam. Lighter soils return a higher sugar content but have smaller and more variable yields. Poor seed, deformed beets, and bruising in handling lower the sugar content.

[1] J. R. Smith, *The World's Food Resources*, New York, Henry Holt and Company, 1919, p. 452

Sugar-beet production requires abundant labor, the United States being handicapped in this respect. The beets must be weeded when young, because they are easily choked out, and the only satisfactory way has been to pull the weeds by hand. Extra labor is also needed at harvest time. Mexicans have supplied a



The Great Western Sugar Co.

Fig. 81. Sugar beets. Note root systems. The roots help break up the soil and upon drying become incorporated with the soil.

great deal of the migratory labor in our sugar-beet industry. Recently, however, machines have been invented for both weeding and harvesting. Those used for the former purpose are estimated to reduce the cost of the operation by one third. The chief growing regions of this country are in the West, where, with the exception of California, labor is very scarce. The crop is usually grown under contract with the factories by small independent farmers and their families, additional help being employed when necessary. Since a sugar-beet factory represents a large capital investment, its owners employ contracts to insure a dependable supply of raw material from year to year to permit economical operation. The beets are grown in rotation with other crops, which may be either beans, dairy crops, potatoes, or small grains. When the land is planted to beets every year, diseases and pests tend to accumulate. The intensive type of operations required for producing beets leaves the soil in good condition for other crops, and high yields are usually obtained.

Areas of production. The bulk of the crop is grown under irrigation in the West. Since sugar beets require intensive methods and return a high value per acre, they fit ideally into an irrigation type of farming, with its high land values and high cost of water. Of late Colorado has contributed about 25 per cent of the domestic output of beet sugar, with California only slightly behind; next in order are Nebraska, Michigan, Montana, and Idaho. There has recently been an increase in production in California and a few of the other western states. In Michigan the crop is not grown under irrigation and the yield is only about three fourths that of Colorado or California.

The average yield in the United States is about 11 tons of beets per acre, with an average sugar content of 16 or 17 per cent. These figures are about the same as those for Germany. The first good beet seeds for starting the industry were smuggled out of Germany through bribery. We have continued to import much of the seed planted.

The industry could be expanded much more in the West with

improved varieties and better methods of cultivation. Recently a variety which resists the attack of certain insects has been developed. This may result in considerable expansion of the acreage.

SUGAR CANE

Requirements. Sugar cane is a product of the wet tropics. In its native home it is a perennial and will grow for several years before a declining yield necessitates replanting. Replanting is done by putting stalks in a furrow. A new plant grows from each joint. In cooler places like Louisiana it must be replanted at least every other year, and sometimes every year. Usually one rattoon crop (one which grows from the stumps) can be obtained in Louisiana. After that the yield declines rapidly. Replanting requires much of the previous crop and is therefore expensive. In Louisiana there is also a large loss because of the deterioration of the planting stock during the cool season.

Sugar cane requires uniform, high temperatures, frequent showers with a total of 50 to 65 inches of rainfall annually, and much sunlight to keep the plant growing. It is said that 80 per cent of the short crops in Louisiana are caused by drought, a problem easily prevented by irrigation facilities, which could be installed more cheaply than in any other sugar-cane area in the world. A dry, cool fall with a shortening period of sunshine is best for the maturing of the plant, and dry weather is necessary for harvesting.

The best soils for sugar cane are water-retaining but well-drained silt or clay loams, with a high humus content and with a well-drained subsoil. The excellence of the delta soils offsets the poor climate to some extent; but a high percentage of clay prevents rapid percolation of water, and ditches must be dug to drain away the surplus water.

The use of machinery requires level fields, while the large investment in the crushing plant, known as a *central,* and in transportation equipment for hauling the cane to the *central* requires a large area where sugar cane can be the main crop. For the most

economical operation the *central* should be in the center of an area of about 5,000 acres. If the land is too far from the mill, time and fuel are wasted in extra hauls, and the investment in transportation is unduly large.

Cheap labor is also necessary. Expensive labor is a major problem in this country, because of the competition of other crops and of manufacturing for labor. A machine has been invented

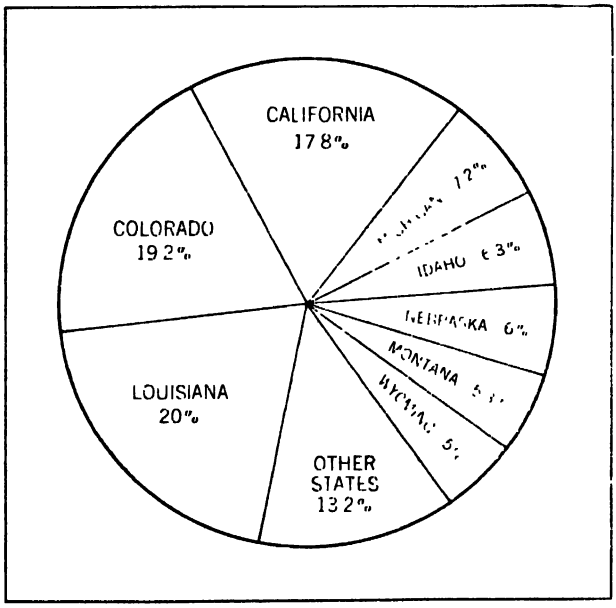


Fig. 82. Rank of the principal sugar-producing states in the quantity of domestic raw sugar produced in 1936

which, it is claimed, will replace 200 men, but so far it has been successful only in cutting green stalks. The dry leaves on the more mature stalks clog its knives. Another difficulty in using machinery is that the stalks do not grow straight, and where ratoon crops are grown, cutting must be done without injuring the stump. A further problem is that the sugar-yielding sap is concentrated at the bottom of the stalk. A hand cutter can cut off the top at the no-profit level, but a machine cannot do so because of the lack of uniformity among the stalks.

Areas of production. Sugar cane is grown commercially only in the almost frost-free area of the lower Mississippi Delta and two minor districts in Texas and Florida. The district in Florida is new, and is claimed by some to have better natural conditions than Louisiana. In Louisiana the water surface of the larger channels provides some frost protection, but nevertheless the industry must face the problems of occasional frost damage and December rains, which cause the crop to ferment. It is grown on the lighter silty and clay loams on the higher levels near the water courses. The yield is about 16 tons of cane per acre, with a sugar content of about 7 per cent.

In Louisiana the crop is grown on large plantations with Negro labor. Many of the plantations are large enough to have their own *centrals,* while others sell to the *centrals* in the locality. Both commercial fertilizer and rotation of crops are employed to maintain the fertility of the soil. About half of the land receives fertilizer every year, and about one third is planted to peas; corn is planted first in wide rows in the spring, and later the peas are planted between the corn. Pasture and grain are thus obtained for the mules, and the corn stalks are a support for the peas, which are later plowed under.

The Gulf States produce a considerable amount of sugar-cane syrup. When the crop is grown for syrup, it is not limited so strictly by climate as when grown for sugar.

Owing to a disease which attacked the plant, the sugar-cane industry of Louisiana declined until, at the end of the decade 1918-28, production was averaging only a little more than one third what it had been before 1918. Now, after the introduction of a disease-resistant variety of cane, which was developed in Java, the industry is again approaching its former importance.

IMPORT TRADE IN SUGAR

From 70 to 75 per cent of our sugar must be imported. Until recently, about half of our total consumption had been coming from our insular possessions, Hawaii, the Philippines, and Puerto

Rico being roughly of equal importance; the remainder was largely from Cuba. Imports from insular possessions have expanded materially since 1929, while those from Cuba, because of legislative control of production there, have declined. The insular possessions have long enjoyed freedom from tariff duties, while Cuba, owing partially at least to the large investment of American capital in its industry, has had preferential tariffs, an advantage which has been increased by a recent trade agreement.

Tariff advantages have been modified somewhat, however, by the quota system, which was established first by the Jones-Costigan Act of 1934 and later by the Sugar Act of 1937. Under this

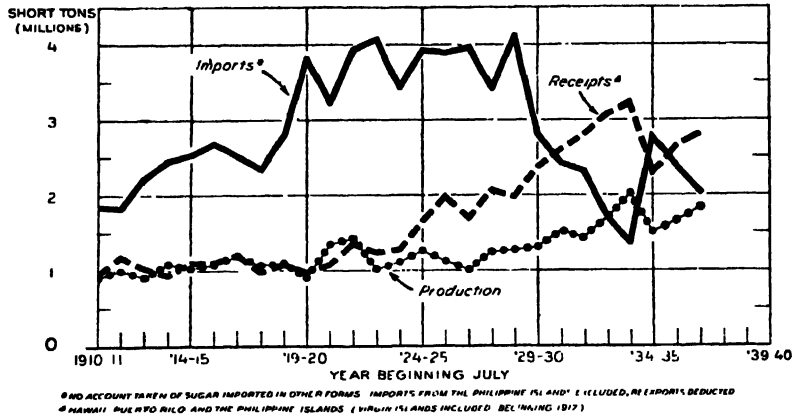


Illustration from Bu of Agr Econ

Fig. 83 Sugar, cane and beet: United States production, imports (duty paid), and receipts from insular possessions, 1910 to 1937

legislation, base quotas are established for all sources, both domestic and foreign. Cuba, for example, is now permitted to send us 2,014,538 tons, which is only slightly more than half of the quantity obtained from there before the depression of the early thirties. Domestic producers have been allotted about 30 per cent of the consumption, 75 per cent of which is to come from beets; Cuba has been allotted 28 per cent, the Philippines and Hawaii each about 14 per cent, Puerto Rico 11 per cent, and other countries the remaining negligible quantity. By this system the price of raw sugar in the United States is at present being

held at about 3 times the world price. Since the consumers of sugar must pay this, several places are thus not permitted to reap the benefits of their natural advantages. Such horizontal reductions are uneconomical if one place can produce at a lower cost than the others; if marginal producers in all regions have about the same unit cost, and the quotas are balanced carefully among regions, no particular harm is done the consumer.

Control became necessary because of the demoralized financial condition of the world sugar industry and because of expanding production in several places, notably in the United States and its possessions. The allotment of quotas has been made in such a manner as will maintain the domestic cane and beet industries at prevailing levels. In case a given region cannot meet its allotment in any year, the quantity by which it is short is distributed among the remaining sources.

The demoralized state of the sugar industry has resulted from overexpansion during the World War, the desire of several countries to have a domestic supply in the event of another war, and scientific experimentation in the sugar-cane industry, which has developed more productive varieties of cane.

HONEY

Uses. The sugars in honey are more easily digestible than other sugars, and are therefore desirable for infants and for persons with impaired digestion. Honey also contains a high percentage of minerals and some protein.

About 250,000,000 pounds of honey are produced annually from 4,600,000 colonies of bees. Bees are kept in all parts of the country except the semiarid plains, where cold and the lack of vegetation are obstacles. Honey is used for table purposes, in bakery products, in confections, and in cosmetics. Much dark or inferior honey is used by the bakery trade to increase the retention of moisture by cakes and bread. Because of the levulose in the honey, bakery products are kept fresh for a longer time than they could otherwise be kept. The poor cooking quality of

honey creates a problem in making confections, but this is being solved by new methods of treatment.

Beeswax, a by-product of honey, is used largely to make candles for the Catholic Church in accordance with an early decree. Next in importance is its use as a base on which bees build comb in the hive. It also enters into the manufacture of cosmetics, ointments, shoe polish, and grafting wax and is used to make impressions in dental work and in lining carboys to hold acids.

Requirements. The moist tropics seem to be the best place for bees, but they thrive in most parts of the middle latitudes if given the proper protection in winter. The chief requirements for successful honey production are a climate that will produce an abundance of nectar-producing plants, and sufficient labor to care for the bees. Careful attention must be given in cold weather, at swarming time, and when taking the honey from the hives. One person with extra help at rush periods can care for about 600 colonies, while one person can look after 250 colonies and still have time to do considerable other work.

Regions of production. California leads the states both in colony productivity, with about 30 pounds per colony, and in the total amount produced. Fruit trees and alfalfa are the sources of nectar. The southern Appalachians have the greatest number of colonies, but the productivity is low, being only about one third that of California. The low yield results from the dependence of the bees on wild mountain flowers for nectar, and from the lack of care.

The irrigated West, in which the industry is well organized, is the leading commercial area. The honey there, because of the source and purity of the nectar, is especially desired for the bottling trade because of its uniform light color, fine texture, heavy body, and delicate flavor. Practically the entire production is from alfalfa and sweet clover. Fruit trees and desert plants provide the remainder. Bees will desert other plants for alfalfa and sweet clover when they start to bloom. The rapid granulation of honey from these plants is an advantage when it must be

shipped long distances. The sweet clover, though grown as a forage plant, also grows wild along the banks of the canals and along the roads. The honey districts average about a mile in elevation. The fertile soil, abundant sunshine, and variations in temperature from day to night because of the elevation are all factors in producing an abundant supply and flow of nectar.

Areas of less importance are the fruit section of New York, the west shore of Lake Michigan, the upper Mississippi Valley, and east central Texas.

OTHER SUGAR CROPS

Sorghum cane. In the broad belt between the sugar-beet and the sugar-cane areas, sorghum cane is grown largely for molasses and for animal feed. This plant is not so restricted by climatic influences as is sugar cane, nor is it so exacting as sugar beets in its labor requirements. It is now grown chiefly in Alabama and the neighboring states.

Maple products. Maple sugar and maple syrup are made by evaporating the sap of several varieties of maple trees. In the early spring when the sap is flowing freely, holes are bored a short distance into the tree. The sap runs out into a container and is collected and carried to a central boiling camp. Maple sugar sells for a higher price than other sugars because of its flavor and because its cost of production is greater.

Vermont, New York, and Ohio are the leading producers of maple products. Almost 13,000 trees are tapped, usually yielding about $1\frac{3}{4}$ million pounds of sugar and $3\frac{1}{3}$ million gallons of syrup. Vermont has about 40 per cent of all of the trees that are tapped, and New York 25 per cent. Vermont contributes about 50 per cent of the maple sugar and 35 per cent of the maple syrup of the country. New York produces almost as much syrup but only half as much sugar as Vermont.

Corn. Both sugar and syrup are made, in glucose factories, from corn and other substances. Corn sugar is an important ingredient of confections.

14
TOBACCO

Early history. Tobacco, now one of the most widely used agricultural products, was unknown to the eastern world until after the discovery of America. Columbus found the natives here smoking and chewing it individually and around the council fires. From America its use gradually spread to Europe. For a time it aroused the opposition of statesmen and church officials, who in some cases prohibited its use altogether and in others attached heavy penalties. In spite of this opposition, however, its consumption spread rapidly during the seventeenth century.

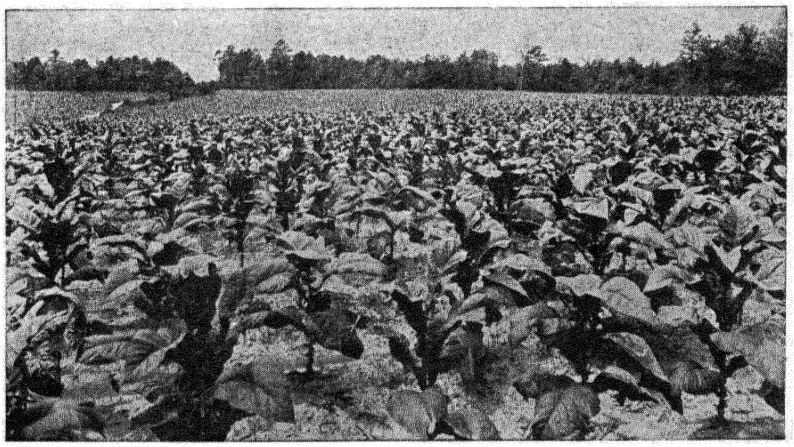
Tobacco has always been an important article of export from the United States. Among some of the early colonies it provided about the only means of obtaining cash to secure necessary imports. Today the United States is the world's leading tobacco growing and exporting country.

Varieties. Of the more than 50 varieties of the tobacco plant, only a few are of commercial importance. The variety which furnishes the greater amount of tobacco, and from which nearly all commercial varieties are derived, is known as the Virginian. Another variety is East Indian or green tobacco, a native of Mexico, now grown chiefly in the East Indies, Germany, and Hungary. Smaller than the Virginian, it has a short, broad stem, more leaves, and greenish-yellow flowers, instead of the pink flowers of the Virginian.

The bright-yellow tobacco of Virginia and the Carolinas has less nicotine than the other tobaccos of this country.

Environmental requirements. The main tobacco region of the United States lies between the cotton belt and the eastern

extension of the winter-wheat region. This fact indicates that the plant is suited to a warm climate. Its production may be widely scattered in latitude, however, because it has a relatively short growing period, but more especially because the plants are started in a hotbed and then transplanted. The growing plants are very susceptible to frost injury. Climatic conditions affect the quality of the leaf as well as the general growth and development of the plant. Although there are exceptions, northern latitudes



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Fig. 84. Field of bright-yellow tobacco (flue-cured) in North Carolina.

tend to produce a relatively thin leaf without pronounced aroma; warmer regions a small, heavy, aromatic leaf.

The plant does best in relatively dry weather, although a well-drained soil will counterbalance some excess moisture. Weather that is too dry causes a thick, close-grained leaf, with poor combustibility. If the season is too wet, the plant shrivels and develops spots in the leaves.

Under given climatic conditions, the class and type of tobacco depend largely upon the texture and physical qualities of the soil. The grade of tobacco, as distinguished from the type, depends largely upon the methods of cultivation and curing. Characteristics caused by the soil may be accentuated by modifying the methods of culture and curing.

Tobacco is grown in soils ranging from light, sandy, well-drained ones to those of a heavy clay or limestone origin. In general, light, sandy soils and loams low in water-holding capacity and low in mineral matter produce a thin, large leaf light in both color and body, finely textured and with a weak aroma. Heavier soils produce a small, dark, heavy leaf with strong aroma. In the case of bright-yellow tobacco, the body and texture depend largely upon the nature of the subsoil.

Climate and soil probably influence tobacco more than they do any other plant. So important are their effects that tobacco of commercial importance is grown in only a few restricted and specialized localities. Different regions rarely produce the same type of leaf, and the purity of any variety can be preserved only by selecting seed from soil that produces it in its original and most perfect state.

Use of fertilizer upon the land is also important in determining quality. Great care must be exercised, however, because of the influence of certain plant foods upon the growing plant. Large quantities of nitrogen cause the plant to become thicker, heavier, and more gummy. If a heavy tobacco is desired, so much the better, as fertilization generally increases the yield, but this would be detrimental if a fine, bright, and thinly textured leaf is desired. This is important in the case of bright-yellow tobacco, which is all grown with the use of commercial fertilizer.

The growing of tobacco. The outstanding feature in the growing of tobacco and preparing it for market is the great amount of hand labor involved. The farmer's income is thus limited to what he and his family with some occasional hired labor can accomplish. This stands out in bold contrast to the growing of wheat, in which the grower's income is limited normally by the amount of capital which he can command. The tobacco seed is planted in a hotbed in early spring, and in six to eight weeks the plants are large enough to be transplanted to the field. Although there are machines for transplanting, this work is usually done by hand because of small fields or uneven surfaces, and the

high cost of the machines. Cultivation and hoeing must begin shortly after transplanting and must be done frequently so long as the size of the plants permits. During the growing period watchfulness must be maintained in order to prevent destruction by insects, of which there are many varieties that may eat the leaves. Sprays are successful against some, but usually the laborers remove and kill pests while doing other work in the fields. If there are many insects, the plants are dusted or sprayed.

In about 60 days after transplanting, topping begins. This consists in breaking the seed stem so that the plant will form good leaves instead of going to seed. After topping takes place, suckers develop and must be removed. A field should be covered two or three times in topping and suckering, the aim being to have all of the plants mature at about the same time. Plants which are late in developing must, therefore, be topped lower. Growers obtain a supply of seed by not topping some of the best stalks in a field.

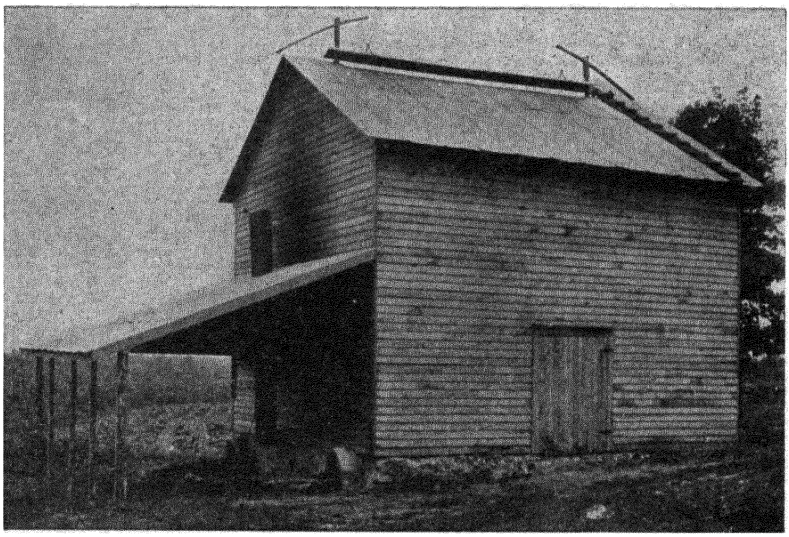
In about five weeks after topping, the plant is ready to be harvested. The leaves may be harvested singly (called priming) as they reach the proper stage of maturity, or the entire stalk may be cut. Harvesting at the proper time is important, for upon that depends to a large extent the development of the desirable qualities of color, texture, and elasticity during the curing process. When the leaves have been cut, they are hung on a pole or a stick in the curing shed, after which the curing process begins.

There are four methods of curing tobacco: sun curing, air curing, fire curing, and flue curing (Fig. 85). Under the first method, which is used on Virginian chewing tobacco, the leaves are dried in the sun, but during wet weather they must be removed to heated sheds. The air-curing process is similar to the former except that the leaves are left hanging in a barn with a free circulation of air. This process requires about six weeks for completion and is used chiefly on cigar tobacco and White Burley.

If the fire cure is to be used, the leaves are hung in a barn until they are a rich yellow color. Then fires are started underneath

the tobacco and are kept going for four or five days, the temperature being gradually increased until it reaches about 150°. The fires are repeated at intervals until the process is completed, that is, until the leaves soften. Export tobacco for England and Africa is cured in this manner.

When the flue cure is used, the tobacco is hung in the shed and heat is conducted into the shed through pipes from furnaces in the outside of the foundation. Over a period of four or five



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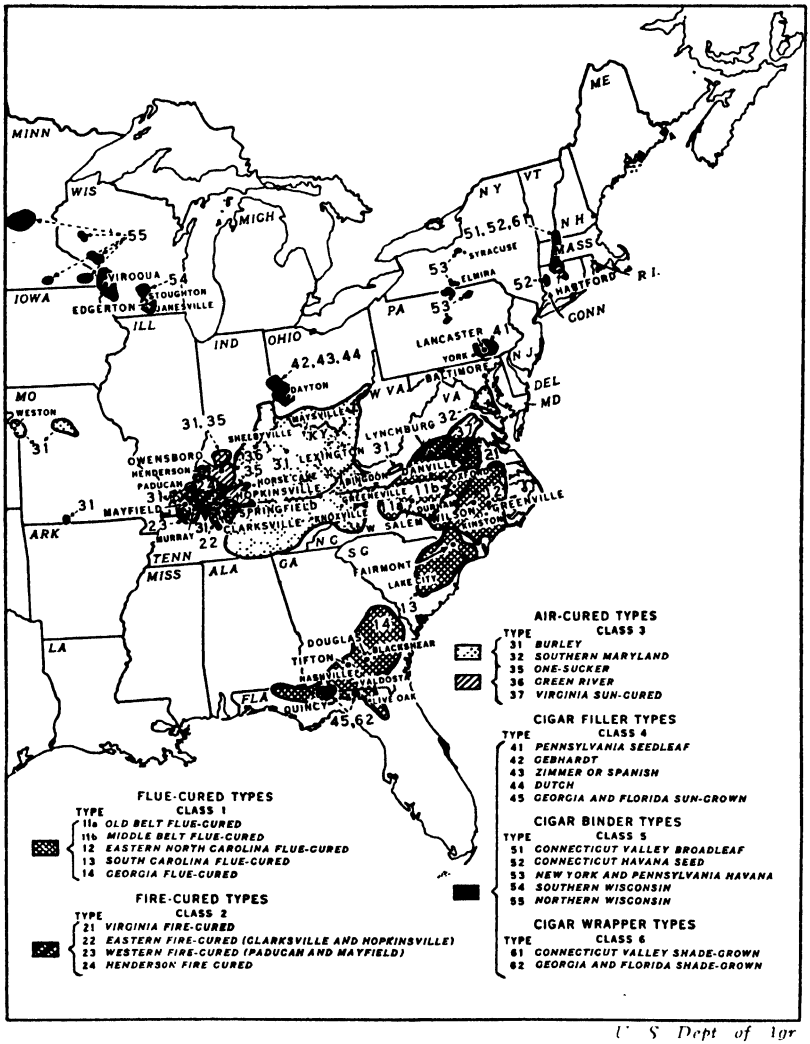
Fig. 85. Tobacco-curing barn in North Carolina. Note the furnaces under the shed.

days the temperature is gradually raised from 90° to 180° or 200°. It is an exacting process, attention being necessary at all times to control the heat so that the quality of the leaf will not be injured.

After curing is completed, the leaves are brittle enough to crumble and break if handled. Consequently, the doors of the barn are opened to permit the leaves to absorb enough moisture to become pliable. When sufficiently pliable, they are stacked in piles to await fermentation (flue-cured leaf is not fermented) and preparation for market. In fermentation there is a chemical change caused by the heat which is generated when the leaves are

piled in heaps. This process mellows the tobacco and improves its color and aroma. Fermentation requires from three to five weeks, and the higher the heat the darker the leaf will become. The leaves are then graded by the grower with respect to texture and color, and are piled away awaiting sale.

Regions of production and types. The major types of tobacco are cigar types and manufacturing types (Fig. 86), the latter



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Fig. 86. Tobacco-growing districts.

being made into cigarettes, chewing and smoking tobaccos, and snuff. During the past two decades there have been important changes in the relative importance of the various manufactured products, cigarettes now requiring almost half of the nation's production of leaf tobacco (Fig. 87).

The bright-yellow-tobacco district of the south Atlantic coastal plain and Piedmont ranks first in production. Bright-yellow tobacco is the leading type used in cigarettes. It is also used for chewing and smoking tobaccos.

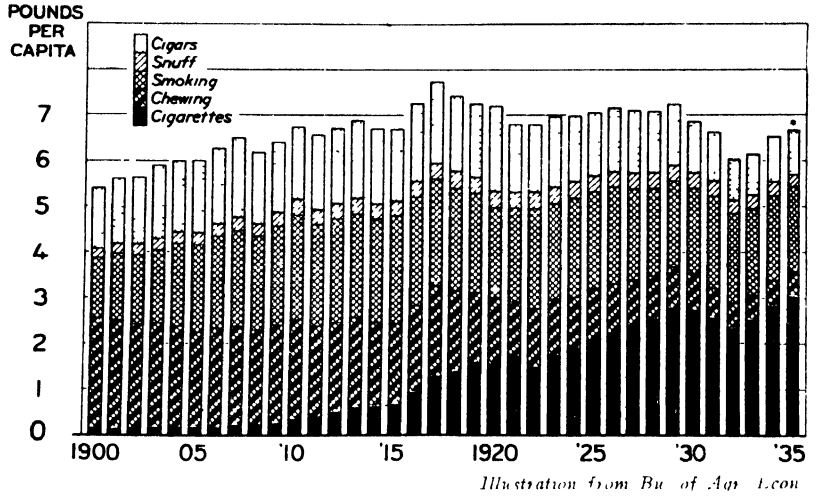


Illustration from Bu of Agr Econ

Fig. 87. Tobacco products consumption per capita in the United States.

The second region is the southern part of the lower Ohio River Valley, chiefly in Kentucky. There are two kinds of districts: White Burley tobacco is grown on the limestone soils of the bluegrass region and to a minor extent in southern Ohio; dark heavy tobacco is grown on the heavy clay loams of western Kentucky and the adjacent parts of Tennessee. Burley tobacco is used in cigarettes but not in as large a proportion as bright-yellow tobacco; it has always been used extensively in smoking and chewing tobaccos, especially the former. The dark tobaccos of the other area are exported and used in the manufacture of snuff, chewing, and some smoking tobaccos.

A third area is the export tobacco section of Virginia and Maryland. In Virginia the crop is grown on heavy loams; in Maryland a mild leaf is grown on light sandy soils. Fire curing prevails here. Nearly all fire-cured tobaccos, except that used for snuff, are exported.

Cigar tobaccos are grown in many widely separated places. A cigar consists of three parts: filler, binder, and wrapper. The binder is placed between the other two parts and is wrapped around the filler to hold it together. It is sometimes omitted in machine-made cigars.

The filler must be uniform in quality and packed longitudinally so that the cigar will burn evenly and the smoke may be drawn through easily. Pennsylvania, in Lancaster and York Counties, leads in the growing of filler tobacco. Some is grown in the Miami Valley and other parts of Ohio, and in New York. Lancaster County is one of the most famous tobacco regions of the nation. It is said that the climate and soil are such that, whatever variety is introduced, continuous planting will produce a long, broad leaf with mild flavor and aroma. The tobacco grown there yields high and is heavier than most other cigar tobaccos because the soil is kept in a high state of fertility by crop rotation (tobacco, wheat, clover, and corn) and animal feeding.

Wisconsin, chiefly in five counties in the southern part of the state, leads in the growing of binder tobacco. Havana strains are grown on sandy and light clay loams.

Domestic wrapper tobacco comes chiefly from New England. Florida and Georgia produce smaller amounts. A portion of the crop is grown under shade, and in Georgia and Florida a leaf similar in wrapping capacity to Sumatra wrappers has been developed. The shade is provided by placing cheesecloth over the field at a height of eight or nine feet. This retards the evaporation of moisture and extends the ripening period. The result is a leaf larger, thinner, lighter in color, and finer grained than those grown in the open. Shade-grown tobacco is produced by corpora-

tions, because the average farmer is unable to bear the necessary expenses.

The Connecticut wrapper is desired by manufacturers because it adds to the quality of the cigar. Some wrappers do not add to the quality, and some even detract from it. The best quality is grown around Hartford. Cuban strains of tobacco are grown; those from Sumatra have failed after considerable experimentation. Thinness and elasticity to give covering capacity are the main requirements of wrapper leaf. It is estimated that two pounds of Sumatra wrapper will cover as many cigars as will from four to ten pounds of Connecticut wrapper.

The celebrated Perique tobacco is grown only at Grand Points in Louisiana. Its aroma and flavor are obtained in the fermentation process. When the leaves are stripped from the stalk, they are placed under great pressure, which is released daily to permit the leaves to absorb the juice which has been pressed out. The change which takes place when the juice is exposed to the air is responsible for the peculiar flavor.

The manufacture of tobacco products. Tobacco products are made chiefly by machine methods in large factories. Only recently have machines been used for cigars. The industry was forced to use them, because of difficulties caused by the shift of consumers' preference to the cigarette. Within each group of products it is largely a battle of brands for markets, a battle fought with expensive advertising.

The different products are made either near the important leaf-producing regions, which also have large supplies of cheap labor, or near the market for the product. The tendency recently has been for manufacturing, with the exception of that of cigars, to concentrate near the raw material. This saves freight charges because the finished articles can be shipped as easily as can the raw product, and are more able to bear the freight rates because of their greater value. The leading state in the manufacture of cigarettes is North Carolina, with factories in Winston-Salem, Durham, and Reidsville. Virginia ranks second, with Richmond

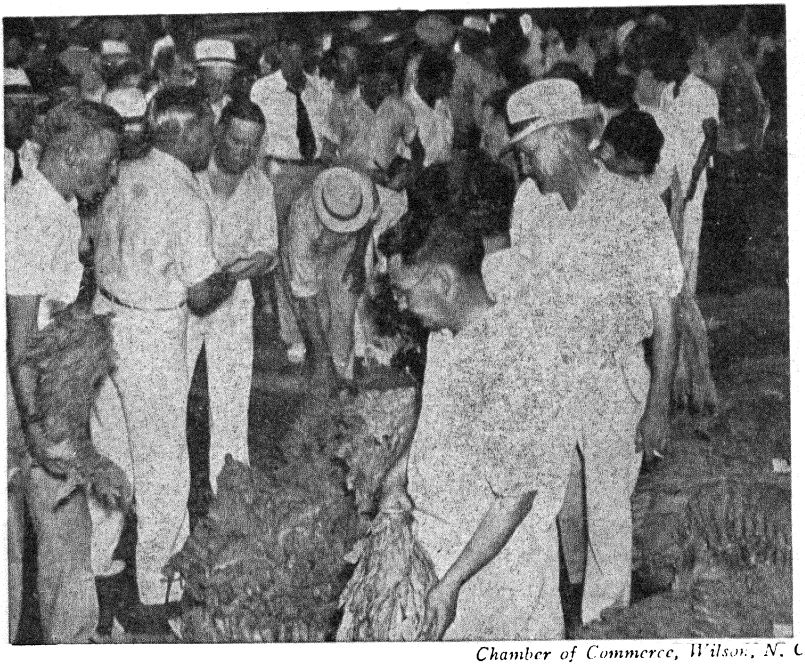
as the center. Louisville, Toledo, the New York City area, and San Francisco also have cigarette factories. North Carolina and Kentucky lead in the manufacture of smoking and chewing tobaccos. Tennessee manufactures nearly half of the snuff of the nation, followed by New Jersey.

Cigars have always been made near their markets, which have been the large cities. Philadelphia leads in the industry, and the district between Philadelphia and New York City is important. Until recently cigars were a handmade product, made in small shops in old buildings or attics, where rents were cheap. The large cities and industrial areas furnished a supply of cheap labor, chiefly women. Since machinery has been adopted, larger factories, and thus more land, are needed, with the result that the factories are going to suburban locations. Machinery was introduced gradually, however, and thus machine and hand methods were employed simultaneously. Skilled labor was also needed, even for machine work, and this was found only around the existing cigar centers. These influences would tend to hold the new factories in the general area of the older ones. Another reason for the manufacture of cigars near their market was the fact that they are bulky and fragile, and thus difficult and costly to ship and preserve. New methods of packing have to some extent overcome this difficulty. Furthermore, it is not so easy to manufacture cigars as it is the other products near the leaf supply, for several types of tobacco, including imported leaf, are used, and these are grown in small amounts in specialized centers. All of these supplies must be assembled, and since cigar leaf is valuable and can stand fairly high freight rates, the greatest economy was in locating near labor and the market.

Both large and small cigars are made. Richmond manufactures most of the small cigars of the nation. In addition to the Philadelphia area mentioned above, Tampa is important in the manufacture of cigars. Because of the higher tariff duty on imported cigars, Havana leaf is imported and manufactured by Spanish workers. Detroit and a number of other cities also man-

ufacture cigars. Small-scale cigar factories are still widely scattered over the nation.

The auction warehouse. Bright flue-cured and some other types of tobacco are sold by what is known as the loose-leaf auction method. The leaf is sold at auction in large warehouses, of which there are usually several in every important tobacco-marketing



Chamber of Commerce, Wilson, N. C.

Fig. 88. Selling scene in tobacco auction warehouse.

town, privately owned and competing for the patronage of the growers. These warehouses are not to be confused with storage warehouses, where the tobacco is stored from 2 to 5 years to age. They are only large buildings where the growers display their tobacco for sale; they operate throughout the selling season, which may last from a few weeks to as long as 4 months.

The farmer brings his tobacco to market in "hands," which are small bundles of 10 to 15 leaves bound together with another leaf, which is wrapped around the ends of the stems. Each farmer's

tobacco is weighed, tagged, and piled on a small flat-bottomed basket, called a hamper, and these are then arranged in lines on the floor of the warehouse (Fig. 88). The auctioneer, followed by the buyers, who are representatives of the large manufacturing companies and of houses which buy for export, goes rapidly along each row of tobacco, as many as 300 sales or more per hour being required in some markets. The owner of the warehouse charges the farmer a fee for the privilege of selling his crop there.

When there are several warehouses in a market and each buyer has only one representative there, selling can be done in but one warehouse at a time, the buyers going from one to another. The sales are rotated from day to day among the different warehouses in order that any one of them will not have the best hour every day.

Foreign commerce in tobacco. About 35 per cent of the leaf tobacco is exported, comprising 6 per cent of our total exports, and leaf tobacco comprises about 90 per cent of the total exports of tobacco. The leading type exported is the bright flue-cured tobacco for cigarettes, but there is also a considerable amount of dark fire-cured tobacco from Kentucky and Tennessee, the dark types being popular on the continent of Europe, where cigarettes are not consumed widely.

The United Kingdom purchases 60 per cent of our leaf exports. Other important markets are in China, Germany, Spain, and Japan. Until 1929 China was a good market, but economic troubles and the spread of tobacco growing there have reduced its importance. The exports of manufactured tobacco products, largely cigarettes, are mainly to the Philippines and Puerto Rico. Exports of cigarettes have declined almost half during the past decade.

Our imports of tobacco are only 8 per cent as large as the exports, the chief types being leaf for cigarettes from Greece and Turkey and for cigars from Puerto Rico and Cuba. There are imports of cigars from Puerto Rico and the Philippines.

15
TEXTILE FIBERS

TEXTILE fibers of both animal and vegetable origin are used by man to supply one of his prime necessities, clothing. Through invention and discovery he has made an increasing number of these fibers serve this purpose. Some fibers have been displaced largely by others, and the relationships among those that are used now are highly competitive. Still others, used but little at present, may become important in the future.

The production of textile fibers tends to become localized. Since fibers are not perishable and usually have greater unit values than food products, they may be grown at points distant from their market. Another feature of the production of most textile fibers is the large amount of labor required to grow or prepare them for the factories—a factor in localizing their production.

Only such fibers as are produced in the United States are included in this chapter, cotton and wool being most important. The annual production of all textile fibers is valued at approximately 80 per cent of the corn crop; it exceeds the value of the wheat crop by nearly 50 per cent.

Cotton contributes about 80 per cent of the total value of the group. These fibers supply the major part of the raw material for the American textile industry, the only manufacturing industry that employs more than one million people directly in manufacturing operations.

COTTON

Uses. Although cotton has been used for centuries, only the invention of the saw-tooth gin enabled it to be produced cheaply

enough to replace linen and wool as a fiber for common purposes. Various textile machines had indeed been invented before the cotton gin, but since the lint had to be separated from the seed by hand, not enough raw material could be obtained to keep the machinery profitably occupied. Now, cheapness and usefulness place cotton first among all fibers that are used, comprising about 85 per cent of the total in the United States. In many parts of the world the use of cotton is even more important than in this country.

In addition to its extensive use in wearing apparel and house furnishings, it also enters into the manufacture of rayon and cellophane. Cotton linters (the fuzz removed from the seeds before they are crushed) and cottonseed have uses which are discussed later in this chapter. The cotton stalk is largely useless at present, except for plowing into the soil to add humus. Recent chemical experiments indicate that in time it may become practicable to cut the entire plant, lint and all, and bale it for use in rayon plants, where all of it will be made into rayon.

Importance of the United States. The United States leads the world in the production and exportation of cotton because of (1) the large area that is adapted to the crop, (2) the cheap supply of Negro labor which has always had the benefit of white supervision, and (3) nearness to markets. This country normally produces more than half of the world supply, and for years it has exported 50 per cent or more of the quantity produced. The chief markets have been in Europe, especially England, but recently Japan has forged to the front (Fig. 92).

The cotton belt. About two thirds of the cotton belt is coastal plain of low altitude and flat to gently rolling topography; the remaining third is within the Piedmont upland, where the altitudes are higher and the surface more rolling. River valleys with strips of fertile alluvial lands extend through both Piedmont and coastal plain areas. Soils are varied in characteristics as well as in productivity. Originally, with the exception of small areas of prairie in Alabama, Mississippi, and Arkansas, and areas of swamp

along the coasts and rivers, the entire region was forested as far west as the black prairies of Texas. Not more than half of this timberland has ever been cleared, and much former cotton land has again grown up in trees. About 20 per cent of the land is suited only to trees.

The boundaries of the cotton belt are determined by climatic factors, the northern by temperature, the other three by rainfall. On the west the climate is too dry, while on the south and the east

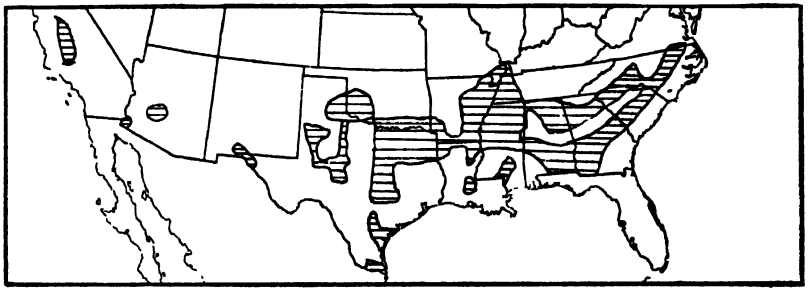


Fig. 89. Areas of heaviest cotton production.

rainfall is too heavy during the harvesting season. Cotton growing is not successful where autumn rainfall is in excess of 10 inches because it damages the lint and interferes with harvesting.

Natural requirements of cotton. Cotton is a sun-loving plant of tropical origin, and is grown widely between the parallels of 37° N. and 37° S. latitude. Conditions of temperature limit its growing more than do those of moisture. The northern limit of the crop in the United States is marked by the summer isotherm of 77°. A growing season of at least 200 days is usually required, although a somewhat shorter one will suffice if one is willing to sacrifice the length of the lint or wishes to force maturity to lessen damage by the boll weevil. To grow long-staple cotton, a growing season of seven months or more is necessary.

Although cotton is grown in a few places along the western edge of the cotton belt where rainfall is only 17 inches annually,

three fourths of the area receives at least 40 inches, and 35 per cent receives more than 50 inches. However, the distribution of rainfall during the year is more important than the quantity. On the whole it is well distributed, the summer months being wettest and the autumn months, or harvest period, driest. The thundershower type of rainfall prevails, with many of the showers coming at night. The region receives about 60 per cent of all sunshine possible.

The eastern part of the cotton belt has the most certain rainfall, and crop failures are rare. All sections are subject to drought, but droughts are more frequent and severe toward the west, where unseasonable frosts and where hot winds during the summer may also do considerable damage.

The best weather for cotton is a mild spring with frequent, light showers followed by a moderately moist summer, warm both day and night, and with a great deal of sunshine followed in turn by a dry, cool, long autumn. Years with a wet spring and autumn usually show the greatest amount of damage in reduced yield and discolored lint.

Climatic conditions influence the character of the lint as well as its yield and grade, the effect being such that graders can recognize the cottons of different sections. Accordingly, the important American cottons have been classed as Texas, Gulf, and Upland. The dry conditions of Texas produce a thicker, heavier, drier fiber than is found where moister conditions prevail. It is superior for spinning unless it is too short. Gulf cottons are medium in length and whiter than the others. Upland cotton is grown in the eastern part of the cotton belt. It varies in color and contains considerable moisture. When mills adjust their machinery to one type of lint, they continue to demand it, for it is expensive to readjust machinery often for different types.

Cotton is grown on a wide variety of soils, ranging from sandy soils to heavy clay; the most productive are the alluvial soils of river valleys. Poor soils produce a low-yielding, small plant which

matures early; fertile soils, a large, late-maturing plant. The staple is usually longer on cotton from the more fertile land. Sandy soils are safer in wet seasons because the plant does not run so much to vegetative growth. Delta cottons have always had first preference, and those of the Texas blacklands are preferred above those grown on sandy soils. As a rule the soils of the western cotton belt are more fertile than those of the eastern. The former are the characteristic soils of grassy regions; those of the east were developed under a forest cover.

The qualities of the soil also have an influence on the susceptibility of the plant to disease. Soils of the coastal plain lack potassium, and it is thought that this deficiency may lower resistance of the cotton plant to the spread of rust. Cotton wilt, widely distributed in the regions of sandy soil as far as eastern Texas, is found occasionally in the Piedmont. Texas rootrot is prevalent in the heavy black soils of Texas and Arkansas. Rootknot is another disease of sandy regions, and is found commonly with wilt.

The boll weevil. Cotton is our only important crop that is subject to the attack of a destructive insect pest throughout almost the entire producing region. This pest, the boll weevil, entered the country from Mexico in 1892, and thirty years later had spread to almost all parts of the cotton belt. In 1921, it damaged 30 per cent of the crop.

The female weevil bores into the young bolls and deposits her eggs. The larvae, when they hatch, cut their way out. This may cause the boll to fall off, or, if it remains, the lint will be cut and discolored where water enters through the puncture.

Various control measures are partially successful. Dusting the plant with arsenate of lead will kill the weevil, but this is so expensive that it usually is not profitable. Dusting by airplane has been used in some places. Cultural practices which force the plants to an early maturity have also helped. As time goes on, continued research should find better methods, so that, even

though the insect is always present, we may always be certain of an average crop, other things being constant.

Since the boll weevil cannot stand hot, dry weather or cold weather, cotton growing has shifted, in the past fifteen years, into west Texas. The crops following a cold winter in the older parts of the cotton region are not damaged so much as those following a normal or warm winter. The Sea Island cotton industry of the Southeast has disappeared because the warm, wet climate necessary for growing the long lint is also ideal for the propagation of the boll weevil. This insect is not present in the irrigated cotton districts of the Southwest, where both the Egyptian and American upland types are produced.

Methods of production. Methods of production vary from one section to another because of custom, and because of physical and economic influences. On the whole, methods are inefficient but are more progressive in the west than in the east. Variations in climate and topography cause much diversity in cultural practices. Where rainfall is relatively heavy, weeds and grass grow rapidly, and the practices differ from those in dry regions. Heavier rainfall necessitates more cultivation and hoeing in the east than in the west; and the Delta area, with its fertile soil, requires 9 or 10 cultivations, compared with 5 or 6 in other sections. Variations in climate also permit different practices in harvesting. In west Texas, with its dry autumns and early frosts, the leaves and late bolls are usually killed. This permits harvesting of all of the bolls at one time, a condition that has favored the development of mechanical equipment for the purpose. Some of the bolls may be missed by such methods, and many defective ones and much trash may be gathered, but the gins have been adjusted to handle this kind of cotton. Though such cotton usually grades lower than handpicked cotton, a farmer, by being able to farm a large acreage, may grow cotton profitably, whereas hand methods might often result in a loss to him. In the east, where the growing season is longer, crops of bolls open in succession, and much good lint

would be lost either by weather damage or by gathering immature bolls if the machine methods were employed. Variations in relief cause a similar division of methods. The large areas of level land in Texas permit the use of machinery for all the operations. The rolling lands and small fields of the eastern area prevent the use of heavy machinery.

Over a large part of the cotton belt the one-mule implement



Illinois Central Railroad Co.

Fig. 90. Cotton-picking scene.

still prevails. In west Texas, however, two-horse, four-horse, and automotive equipment is used. As much as 100 or 200 acres of cotton, with as great an acreage of one or two other crops, may often be found on a single farm. The average acreage per farm in other sections is less than 20. Furthermore, not much but cotton is grown, the few supply crops that are planted not receiving much attention. Labor and fertilizer go largely to the cotton crop. The small-scale equipment is largely a result of economic conditions. In the first place, the grower has to be financed

every year, and thus tries to get along with as little capital investment as possible. Consequently, he can never get a surplus for more equipment. Since much of the feed is imported from other parts of the country, more work animals would only require more feed, and, as cotton is partly a hand-labor crop and other crops are not grown much, the work animals and equipment would be idle a large portion of the time.

The use of fertilizer is normally important east of the Mississippi River. In the South Atlantic region it is applied to practically all of the cotton acreage. The eastern Gulf States probably use it on 60 per cent of the acreage. Farther west, where the newness and nature of the soil and the uncertainty and dryness of the climate make heavy applications hazardous, but little fertilizer is used.

After the cotton is picked, it must be ginned to separate the seed from the lint. The weight is usually about one-third lint and two-thirds seed. The gins are located centrally in the towns, to which the farmers of the surrounding country haul their cotton. After it has been ginned, it is made into bales of about 500 pounds each. The farmer very often sells them at once, though he may hold them for a better price.

One-crop agriculture. The cotton and also the tobacco areas of the United States are always used as examples of the bad economic and social conditions that result from a one-crop agriculture. The South has been criticized for not diversifying its agriculture. There is some diversification locally, but events of the past 15 years have resulted in greater, rather than less, specialization on cotton and tobacco. As was explained above, the effect of the soil on the quality of the leaf limits the rotation of crops in the bright-yellow-tobacco districts. In the case of cotton, labor requirements conflict with those of the different crops which might be grown, while other sections of the country are better adapted to these crops. The cotton belt, therefore, is often able to buy its crops for less than their local cost of production. The great sur-

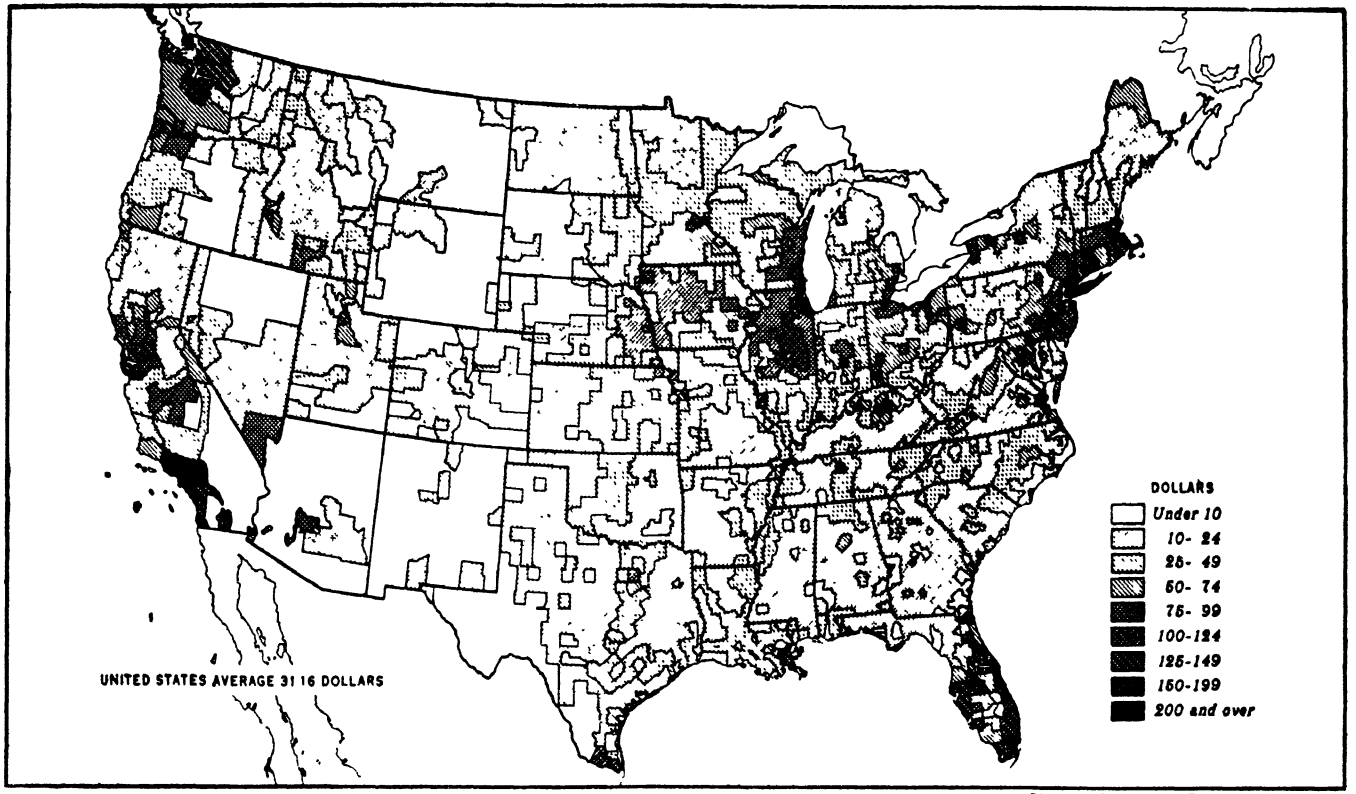


Illustration from Bu of Agr. Econ.

Fig. 91. Value of farm real estate per acre, January 1, 1935

pluses of grain and animal products since 1920 have operated still more to concentrate their production in the Middle West.

The present landholding system of the cotton belt and the credit system resulting from it seem to be about the worst that could be devised. No one is directly responsible for them; they have developed from local and regional conditions. When the Civil War ended, the plantation owners had no way to work their land, except to rent it in one way or another to the former slaves. The freed slaves had nothing and had to be financed if they worked the land. In order to be more certain of the repayment of the loan, the creditor—landowner, supply merchant, or banker—forced the tenants to grow money crops of a variety which could not be consumed on the farm. This system still prevails. In addition, the majority of the landowners, many of them absentee owners, have been interested chiefly in obtaining as much money as possible from the land, without much consideration as to what was happening to the land, to agriculture in general, or to the welfare of the agricultural population. Yet, as a class, the owners have not profited unduly. Diversification, supervision of the tenants, and operator-ownership all have proved their worth in various sections.

One-crop agriculture is destructive of the soil, but it must be remembered, as has been stated previously, that it is much more difficult to maintain soil fertility in the cotton belt than in other farming sections of the country. The soil was not originally fertile, and its texture, rolling topography, warm climate, and the methods of cultivation required have combined to cause excessive erosion, much of which, however, is being corrected. The difficulties here, however, are greater than in our grain regions.

Manufactures of cotton. The lint and seed are both used for manufacturing. The textile industry is discussed in a later chapter. Cottonseed is crushed in mills, which also crush other vegetable-oil seeds, throughout the cotton belt. The leading center is Memphis. The oil is used in making butter and lard substitutes and various other products, such as salad oils and dressings. The

cake which remains after crushing is a good stock feed and fertilizer. As a feed it is excellent for fattening cattle, and much is exported to the dairy sections of northwest Europe. Linters are employed in making rayon and munitions, but are used chiefly in the manufacture of mattresses, furniture, and other products in which a packing is necessary.

A price-control system for cotton. The price of cotton fluctuates greatly from season to season. The large proportion of the world crop grown here, variations in weather, and the fact that growers increase acreage after a short crop but do not reduce it after a heavy one all combine to produce marked fluctuations in prices. The resulting instability in the industry has created a demand for some sort of a production-control or price-control program. Various measures have been tried, but none has been entirely satisfactory. One of the problems is to maintain millions of people on the land in the Southeast in face of the competition of western cotton lands with their large-scale machine methods and consequent low unit cost, estimated to be as low as 6 cents a pound in parts of west Texas. There is both a social and a production problem. The application of more efficient methods of agriculture would probably make cotton growing more profitable for the much smaller number of farmers required to grow the crop. Not all of those displaced, however, could hope to find other employment. In the long run, industrialization might provide greater employment. Unfortunately, the majority of the new manufacturing industries arising in the Southeast are not of a type that employs large numbers of workers. Large acreages of other crops are out of the question, because the cotton belt cannot compete in national or world markets in their production.

International issues, also, are involved. Foreign textile centers, dependent upon American cotton for their raw material, are opposed to artificial price increases. The stabilization of price at a relatively high level may make the growing of cotton profitable in new regions, this having been the effect of our recent federal agricultural program. Once cotton growing is established in new

locations, the industry gradually gains momentum, which makes it more difficult for our cotton to regain or to maintain its competitive position.

Apparently the South must continue to grow cotton on about the scale at which it has been grown. The prevailing opinion among economists is that the region should continue to specialize in the crop for which it is fitted by nature and that nothing should be done that would seriously injure its competitive position in the trade. This, however, does not preclude the adoption of many practices which, in the long run, might result in a more stabilized

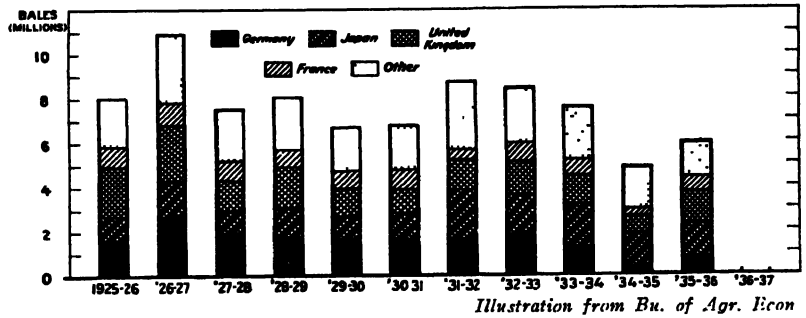


Fig. 92. United States cotton exports by countries, 1925-26 to 1936.

industry and greatly improved economic and social conditions among the cotton growers.

Foreign commerce in cotton. Cotton ranks first among our exports, amounting now to about one sixth of the total. From 50 to 55 per cent of the crop is usually sold in foreign markets. The textile centers of Great Britain and Europe, collectively, take first rank as purchasers of American cotton, but for several years Japan has been the leading single market (Fig. 92).

Our cotton, moreover, is meeting increasing competition in world markets. Great Britain has not been satisfied with such great dependence on a single source of supply and, consequently, has encouraged the growing of the crop in her colonies. Though the crops have not been large, the quality is of the high type demanded by British mills for their production of goods of superior quality. With the improvement in the quality of British manu-

factures, the demand for raw cotton has decreased, because more labor is put on a given amount of raw material, and the demand is for the types of longer staple. At the same time, the quality of our raw cotton has deteriorated because of careless methods of production and marketing, and also because a large part of the crop is now being grown in the western part of the cotton belt, where the season is shorter and the climate drier than in the Southeast. Japan buys more here when the price is low, but tends to

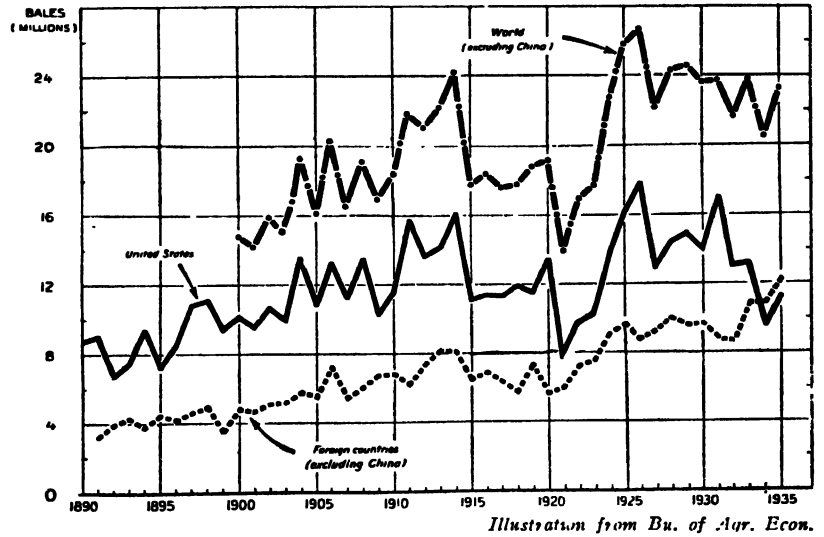


Illustration from Bu. of Agr. Econ.

Fig. 93. Cotton production: United States, foreign countries, and world, 1890 to 1935.

buy more of the short staple of India when our prices increase.

Imports of cotton into the United States are small, being confined almost entirely to long-staple cotton for special purposes, imported mostly from Egypt and Peru.

HEMP

During colonial and frontier days, hemp was used for clothing, for sails on the famous clipper ships, and for covers on the wagons that carried the pioneers westward. Recently, however, it has been supplanted to a large extent by cheaper fibers or by fibers that are better for certain purposes. Manila hemp is now used in

marine cordage because it floats better than common hemp and is more resistant to injury from salt water. Cotton, jute, and sisal are used in its stead for twine, although such twines, when ex-



"Yearbook of Agriculture" for 1913.

Fig. 94. Two types of hemp plant.

posed to the weather, do not have the strength or the durability of hemp. At present hemp is used chiefly for wrapping twine, fishing lines, and carpet warp.

Hemp requires a cool, moist climate free of frost for four months, and a silty soil. At one time it was an important crop in

the bluegrass region of Kentucky, but now southeastern Wisconsin grows 75 per cent of the total of about 1,600 acres. Neighboring states and California have small acreages. In several places it is grown for destroying weeds. The total acreage now is only 20 per cent of that of 1919. Several varieties are grown, those of Chinese and Japanese origin being most important. After being cut, the stalks are left on the ground until the leaves fall off. Then they are stacked and retted with water during the winter.

WOOL

Nature and importance. Wool, obtained from sheep, is the leading animal fiber, and world production is usually about 30 per cent as great as that of cotton. Wool fibers are hollow, are covered with interlocking scales or serrations, and, when examined under a microscope, have somewhat the appearance of a pine cone. The serrations, which cause the different fibers to hold together, and the curl, or crimp, of the fibers, which provides air spaces, make wool a poor conductor of heat, a property highly desired in clothing material. Wool is also strong and durable, and the curl of the fibers imparts elasticity, which enables them to assume their normal shape after being stretched.

Since sheep supply meat as well as wool, their distribution and the geographic and economic influences which control their production are treated in greater detail in the following chapter.

Types of sheep. There are three types of sheep: (1) wool, (2) mutton, and (3) dual-purpose, the latter resulting from cross-breeding the other two. Mutton sheep are better producers of wool than wool sheep are of mutton. The dual-purpose type produces neither as good wool nor as good mutton as the specialized types, but in the United States the combined cash return is usually greater. There are several breeds of sheep within each class and consequently much diversity of qualities of wool. Soil, climate, and feed also affect the quality of the wool. There are said to be more variations of economic importance among sheep than among any other animals.

Sheep are native to the cool, dry plateaus of Central Asia. When sheep are taken to warm regions, their wool, unnecessary for protection, tends in time to become straight. Even in Australia, where the world's best wool is grown, new breeding stock must frequently be brought from cooler Tasmania in order that the quality of the wool will not deteriorate. Sheep bred for mutton require a damper climate and better pasture than do those bred for wool.

The leading wool breeds are the Merino and the Rambouillet, native to Spain and France, respectively. There are also cross-breeds which have a preponderance of one or the other of the two. Both have been crossed with mutton breeds in this country, but the mixture of Rambouillet blood is the more important. The many folds in the skin of wool breeds provide a large wool-bearing surface (Fig. 99).

There are two types of mutton breeds, the medium-wool and the long-wool. The leading breeds of the former class in the United States are the Shropshire, Southdown, Hampshire, and Oxford, the first two being most important. The Shropshire is particularly popular because it is prolific, matures early, has a sturdy frame, and is well adapted to good pastures; it is perhaps not quite so hardy as some of the other medium-wool breeds. The more important long-wool breeds are the Lincoln, Cotswold, Leicester, and Romney Marsh, the latter two being of the lowland type of sheep, which are larger than the upland type. The Romney Marsh has been bred for long in a swampy area in southeastern England and is raised under similar conditions in New Zealand and in Argentina. It is a good forager, resists stormy weather, and produces a heavy fleece.

Classes of wool. Wool is graded according to the diameter of the fiber as fine, medium, and coarse. The greater part of the domestic production is of the first two. Fine wools, which are also shorter (1 to 2 inches) than the others, are from wool breeds. They are used in fine dress goods and flannels. Some short wools are combed (the shorter fibers being removed, leaving the longer

ones parallel), but usually they are only carded before being spun into a yarn. Since fine wools come from breeds that are not the best for mutton, they are usually produced in regions, like the intermountain territory, that are far from market or where water and forage are not plentiful. Some fine wools are produced in southeastern Ohio and at other points in the grain belt, but most of them are from the western ranges.

Though the better qualities of medium wools are used for fine dress goods, the bulk of this type goes into coarser material for garments. There has been an increasing amount of this wool as a result of crossing fine-wool and long-wool breeds on the western ranges.

Long wool is coarse and strong. The better grades are used for coarse clothing material, but the greater share is used for heavy overcoats, blankets, carpets, and knitted products. Long-wool breeds have been introduced recently into various districts of the Pacific Northwest. Both medium and long wools ($2\frac{1}{2}$ inches or longer) are used a great deal for combing wools, which are made into worsteds.

A fleece, that is, the wool shorn from a sheep at one time, grades into several classes of wool, the best quality being from the shoulders. The average domestic fleece weighs about 8 pounds; this is 4 times the average a century ago.

The United States as a wool producer. This country produces about 10 or 12 per cent of the wool of the world. It recently ranked next to Australia, with a quantity about half as large. After a marked decline in the number of sheep and the quantity of wool between 1910 and 1925, the trend has reversed itself and the production of wool is now averaging from 65 to 70 per cent above that of a decade ago, with an increase of 50 per cent in the number of sheep.

Imports of wool. Imports of wool average about a third of our total requirements for wool. Recently 75 per cent of the imports have been of carpet wool, there having been a marked increase in this type since 1920, accompanied by a heavy decline in the im-

ports of other types. While imports are received from many countries, Argentina and China are ordinarily the two foremost sources, each supplying about 25 per cent of the total. Other important sources are the United Kingdom, India, Australia and New Zealand, and Asia Minor. Our annual consumption of wool is normally about 600 million pounds, a quantity sufficient to make four suits of clothing for every man in the country.

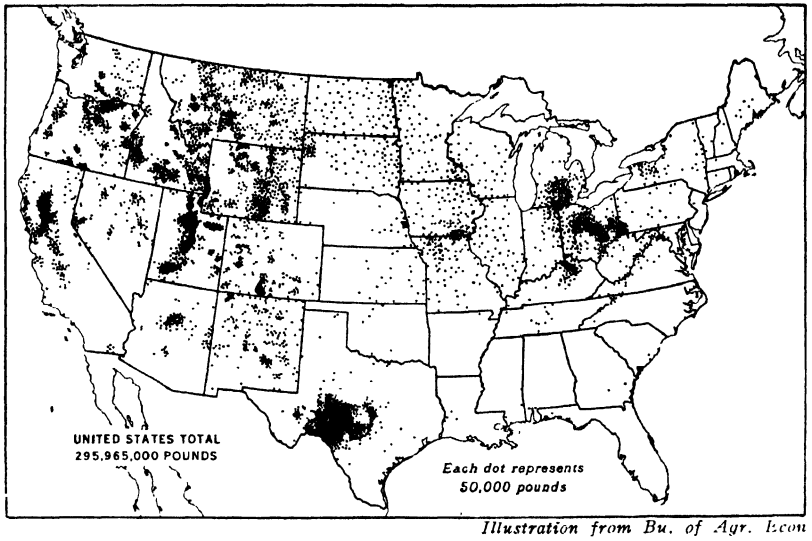


Illustration from Bu. of Agr. Econ

Fig. 95. Wool-producing areas of the United States; wool produced in 1929.

MOHAIR

Mohair is the hair of the Angora goat, a native of Turkey. Mohair is valuable because of its length, softness, luster, elasticity, and other qualities. It is used largely in house furnishings, garments, and upholstery; the automobile industry is the leading consumer, using about 40 per cent of the total output for upholstery. The goats are clipped twice a year in this country, about 4 pounds of hair, varying from 6 to 12 inches in length, being obtained annually from each goat.

The industry started about 1850 when the Sultan of Turkey

made us a gift of blooded animals, which ranchmen in the Southwest crossed with the ordinary Mexican goat. The Edwards Plateau in Texas produces from 85 to 90 per cent of the mohair of the country.

16

THE ANIMAL INDUSTRIES

ANIMALS are important to man for several reasons. They (1) furnish him with power with which to do much of his heavy work; (2) provide such products as meat, milk, eggs, leather, and wool; and (3) are a means of helping to maintain the fertility of the soil because of the manure which they return to the soil and because of the variety of crops which must be grown for their upkeep. It is said that many beef cattle are fattened in the United States only to maintain soil fertility, the value of the manure being the chief profit from the enterprise.

It is difficult to imagine how civilized man could exist without animals to supply him with food, clothing, and draft power. The use of animals for draft purposes marks one of the great steps in the rise of civilization, little progress having ever been made by groups until animals were tamed and used as beasts of burden. The lack of progress among the American Indians, when they had this continent to themselves, was due, in part at least, to the lack of draft animals. They had nothing with which to supplement their own power and thereby create the surplus of products or wealth which forms the basis for all progress.

BEEF PRODUCTION

Importance of meats. Meats seem to have an important effect on people's health and working efficiency. Too much meat in the diet may be harmful, but a certain amount seems to be very beneficial. One of the most important functions of meat is to serve as an appetizer. It flavors other products and acts as a stimulant to the digestion of them. Because of its protein, meat is a muscle-

building food, and has great heat-producing power, which accounts for its heavy use by those who work outdoors in cold weather.

Desirability of cattle. The size, strength, speed, and hardiness of cattle, their ability to stand heat and moisture and to combat danger, and their adaptability to different uses have caused them to be one of the most favored of all types of livestock. In the United States, cattle are generally kept either for beef or for dairy purposes. Some farmers prefer a dual-purpose type, especially where the market demands for dairy products do not justify intense specialization—a situation not uncommon along the marginal areas of the corn belt.

Breeds of beef cattle. The important breeds of beef cattle are the Shorthorn, Hereford, Aberdeen-Angus, and Galloway, all of which developed in the British Isles. Of these breeds the first two are of most importance, and of these two, the Shorthorn is the more widely raised.

The striking characteristic of the Shorthorn is the ease with which it adapts itself to varying conditions of soil, climate, and management. Herefords are hardy and docile; they develop early, and produce an excellent quality of beef. They also fatten easily and, being excellent grazers, are desirable on the ranges. The mature animals are about the size of mature Shorthorns, but the young animals are heavier than the young Shorthorns. The Aberdeen-Angus are large, make good beef, and are fine show animals. Galloways are suited to a wetter climate than the Aberdeen-Angus. They are good grazers, hardy, and about equal in size to the Aberdeen-Angus, but yield a superior quality of beef, and they mature more slowly. Their hides, because of their shaggy hair, are valuable for robes.

Factors affecting the distribution of beef cattle. In regions not well suited for tillage agriculture and where native grasses are fairly plentiful, beef animals predominate. In such regions market centers for dairy products are usually remote, local population

is sparse, and land is relatively low priced. In the United States many cattle are pastured on the ranges all summer, and in the autumn are shipped into the corn belt to be fattened on grain before slaughtering. This procedure is cheaper because the corn belt is closer to the beef-consuming centers, and cattle can be transported at a relatively lower cost than can the feed which they consume.

Another influence is the degree to which a country has become developed and industrialized. The production of beef cattle has

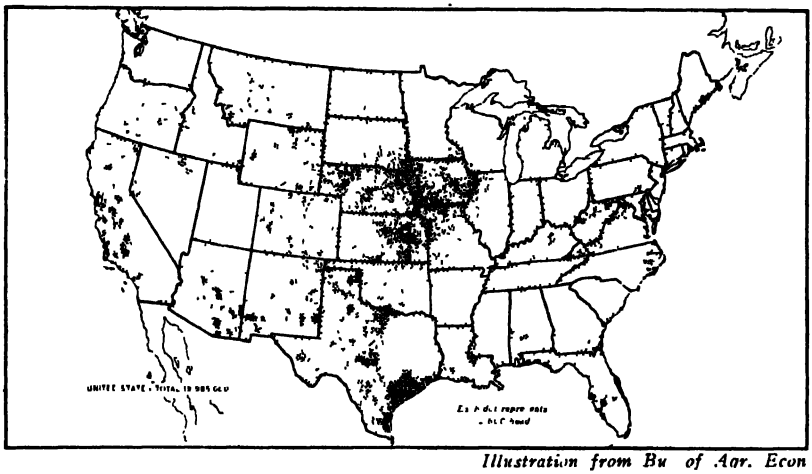


Illustration from Bu of Agr. Econ

Fig. 96 Beef cattle (excluding calves and bulls): number on farms and ranges, April 1, 1930.

been largely a frontier industry. For, as population increases, land values rise, and other types of farming, such as dairying and general farming, become more profitable and tend to crowd the beef-cattle industry into newer regions.

Regions of production. Four regions which produce beef cattle may be noted (Fig. 96): (1) the corn belt, (2) the western range, (3) the cotton belt, and (4) the middle Appalachians. The corn belt is the chief fattening area, while the range and the cotton belt largely supply feeders to the corn belt. More cattle are pastured, however, in the grain-producing sections than are

grazed on the range. Southwestern Wisconsin, the Flint Hills of central Kansas, and the middle Appalachians are regions where grass-fattened cattle are marketed, but the majority of beef cattle are finished on grain feed.

Cattle feeding, much of it finishing range animals for market, reaches its maximum in the western part of the corn belt, because that section is farthest from the central grain markets. There is therefore an economy in transportation in feeding the corn to livestock. Nebraska ordinarily ships more cattle to market than any other state. Cattle raised in the region are pastured during the summer, and this supply is augmented by range cattle shipped in during the fall. After the corn is husked, the animals are pastured in the stalk fields, after which they are fed in yards and thus finished for market, usually before June. Most beef cattle are now marketed as two-year-olds; twenty-five years ago chiefly three-year-olds were marketed. The major cause of this change is the demand from people in the cities for tender meat. Movement of people to the city with its cramped living quarters also has caused a demand for smaller cuts of meat. Furthermore, there is greater economy for the farmer in marketing cattle at a younger age, and an economy in the use of the beef-producing resources of the nation.

On the western range, much of it mountainous, summer grazing prevails at the higher elevations and winter grazing at the lower, supplemented with hay when necessary. In the southern sections cattle are usually grazed all winter at the lower altitudes.

The cotton belt would be a good cattle region if the tick and other parasites could be controlled and if cotton did not offer so much competition. More scientific and business-like methods than now prevail, however, are needed. There are now a few cattle on most of the farms in this section, and in most parts they can graze all winter. Considerable success has been attained with crossing Brahman cattle with the European type. Though the offspring, like its Brahman parent, is immune to tick, it does not make as desirable a beef animal as the European type.

DAIRY PRODUCTS

The efficiency of dairying. Milk contains all of the elements necessary to nourish and maintain the human body, and has no equal as a source of calcium in the diet. It also contains several of the vitamins, particularly A and G. It is the most nearly perfect of foods and also one of the most economical to produce. According to the United States Department of Agriculture, the dairy cow, for the amount of feed consumed, returns about four times as much digestible protein as does the steer, over twice as much energy in edible products, and $5\frac{1}{2}$ times as many calories of fuel. Beef has about 5 times the food value per unit of weight that milk has, but a given amount of feed will produce many times more milk than beef. The dairy cow thus converts various rough products into one of the best of foods. The average annual consumption of milk per capita in the United States, reducing cheese, butter, and so forth to their milk equivalent, is about 95 gallons.

Dairy farming, because it is intensive, can more easily be made to pay on high-priced lands than can other types of livestock industries or grain farming. The income is steady from month to month, and farm labor may be utilized more efficiently than in the production of most other farm products. Moreover, animals from the herd may be sold for beef. Nearly one fourth our production of beef is from old cows, undesirable animals, and young calves that are sold from dairy herds.

Requirements of dairying. The best natural dairy regions are those with a cool, moist climate where rainfall is evenly distributed, and with well-drained, moderately fertile soil which holds water well—conditions favorable for a good growth of grass. Economic factors, however, are sometimes more important in locating dairying than the geographic. Because of the demand for fresh milk, dairying is always important near large cities and densely populated industrial districts. Dairying is also important where hay is grown extensively and where grains are cheap—in the corn belt, for example.

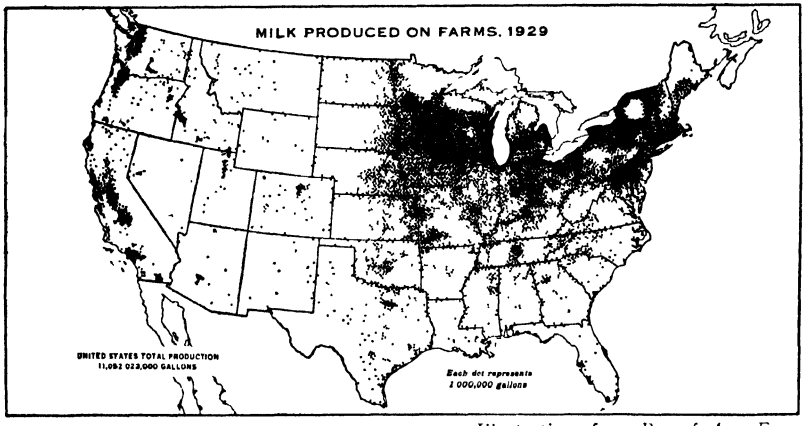
Breeds of dairy cattle. The chief breeds of dairy cattle are the Jersey, Guernsey, Ayrshire, and Holstein-Friesian. Although selection and breeding have been important in their development, the force of natural factors is evidenced by certain characteristics of each breed. The Holstein-Friesian and Jersey stand in striking contrast to each other. The native home of the former is the North Sea region of the Netherlands, where the cool, moist climate causes a heavy growth of grass of high water content. During their heaviest milking period the cows must obtain nourishment from this watery grass, and, consequently, they must eat large quantities. For this reason, the cows have developed a large abdomen and large digestive capacity, which has resulted in a large rather rawboned type of cow that gives a large amount of milk not very rich in fats.

The Jersey breed developed in the Isle of Jersey, where the climate is milder and drier than in Holland. Since the grasses there are not so high in water content, a cow does not require such a large amount to obtain the proper amount of sustenance. As a result, the body of a Jersey is of moderate size, and she gives a moderate quantity of milk rich in fat.

The Guernseys developed under about the same conditions as the Jerseys. Neither of these breeds can withstand as cold weather or as rough treatment or can utilize as rough feed as can the Holstein. The Ayrshire breed developed in the uplands of Ayr in Scotland, where climate and soil were poor and forage scarce. They are able, therefore, to do better on scantier pasture than can the other breeds.

Types of dairy farming. There are three types of dairy farming: (1) the production of fresh milk for immediate consumption; (2) the production of milk to be made into butter, cheese, condensed milk, ice cream, and so forth; and (3) the production of breeding stock. Although the last-named type is often carried on in combination with the first two, there are many farmers who make a specialty of developing good breeding animals. The first type is dependent on near-by markets and is, therefore, lo-

cated near densely populated districts. People resort to the second because it is more profitable than the production of other farm products or because of the distance to market. This is the type of dairying found on the general farm, where it is only one among several activities. About 21 pounds of whole milk are required, on the average, to make 1 pound of butter. Normally, between 60 and 65 per cent of the cash received from the sale of dairy products is from the sale of fresh milk. Of the total production of milk on the farms, 40 per cent is sold fresh and 35 per cent is separated and the butterfat marketed.



Illustrations from Bu. of Agr. Econ.

Fig. 97. Milk produced on farms.

Regions of production. Dairying is an industry which is widely scattered, but because of favorable natural factors or the location of markets, certain regions have specialized and become important centers for the production of different dairy products. Regions also tend to specialize on certain of the products because of the difficulty of establishing a reputation for dairy products. The world's most important large dairying region is the northeastern section of the United States and adjacent parts of Canada. Here is a cool, moist climate, and land that is not suited well to grains. These conditions, which limit other crops, make it a natural dairying region. In addition, its location with respect to

markets is most fortunate, being along the northern edge of the densely populated manufacturing district which extends from the Chicago area eastward to the Atlantic. It is also adjacent, for the most part, to the important grain sections with their low-cost grain and mill feed.

Generally speaking, the eastern end of the dairy region produces milk for immediate consumption because of its location near the large industrial centers. Much fresh milk is marketed in the western part of the dairy belt, but the demand is more limited and a large part of the production must be converted into the less perishable and more compact products. The recently invented thermos car, however, has made it possible to ship milk and cream for long distances.

SWINE

Desirability of swine. Swine are grown more widely throughout the world than any other meat animal. The reasons for their wide distribution are: (1) the ease of producing them, the hog being a scavenger and an animal which will fatten on a wide variety of products; (2) their prolificacy, the annual increase being from 1,000 to 1,500 per cent; (3) the number of varieties, which makes them adaptable to widely different conditions; and (4) the rapidity with which they reach maturity, usually being ready for market when from six to nine months of age. Swine give a quick return with a minimum of expense, and return more food in proportion to the food consumed than do other meat animals.

Factors controlling the distribution of swine. Economic influences, rather than climatic, are largely responsible for the distribution of the commercial swine industry. The small stomach of the hog requires that it have a concentrated type of food, such as cereals or nuts. Consequently, it will be grown where such kinds of food exist. The cost of transporting these foods to market is another influence controlling distribution. Cereals may either be marketed as such, or they may be fed to animals. The nearer the market are the cereals, the less important are animals because of

the small expense in transporting the cereals. But as the distance from the market increases, the production of hogs becomes more important because of the relative costs of marketing. Thus, Iowa has more swine relative to the amount of corn grown than Illinois has.

Types of swine. There are two types of swine, the lard type and the bacon type. The feed and the breed are both important in determining the type. The lard type is short and blocky and squarely built; the bacon type is more angular and rangy, and usually smaller. With a change in feed, the lard type can be made to produce a fair quality of bacon, and the bacon type a larger amount of fat. Where the hogs are fed on barley, pasture, and skim milk, the tendency is to produce more bacon; where the feed is largely corn, the tendency is to produce more fat. The trend, recently, in the United States, has been to produce more bacon, because people in the cities, where work is less strenuous than in the farming districts, do not need so much meat or so much fat.

Breeds of swine. The principal breeds of swine of American origin are the Chester White, Poland China, and Duroc-Jersey. They were developed by the crossing of different breeds brought from Europe; but they have reached their present state of development through selection and breeding in this country. The Chester White is a breed of large size which matures slowly, and is not highly prolific. It is not grown so extensively as the other breeds. The Poland China is a hog of medium size, matures probably more rapidly than the others, but is not prolific. The Duroc-Jersey, which is most widespread, is a hog of large size, matures early, and is very prolific. These breeds are the lard type. Important bacon breeds are the Berkshire, Hampshire, and Tamworth. They have been developed in England.

Regions of production. The United States has about one third of all the swine of the world and a little less than all of Europe. About half of the total number are found in the corn belt, one third of the American corn crop being marketed in the form of

pork. In some places, hog production extends beyond the corn belt. To the north, the industry is an adjunct to the dairy industry. The hogs are fattened on skim milk, barley, corn, and mill feed. One hundred pounds of skim milk are equal in feeding value to one bushel of corn. Some are found in the West, where they are fattened on alfalfa and barley; and the Southern States also produce many, the industry there being an adjunct to the other agricultural industries. Many of the southern hogs are allowed to run in the forests, where they fatten on roots and nuts, which produce meat of a better flavor than that of the corn-fed hog. Many also are fattened on peanuts.

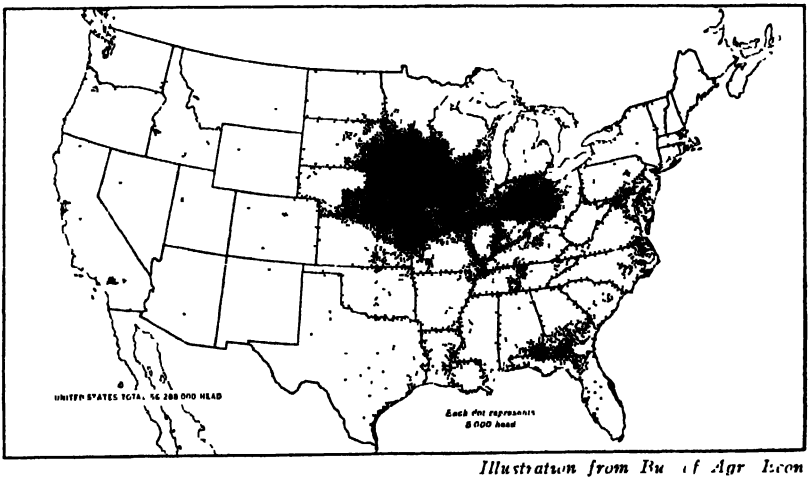


Illustration from Bu of Agr Econ

Fig. 98. Swine on farms; number, April 1, 1930.

SHEEP

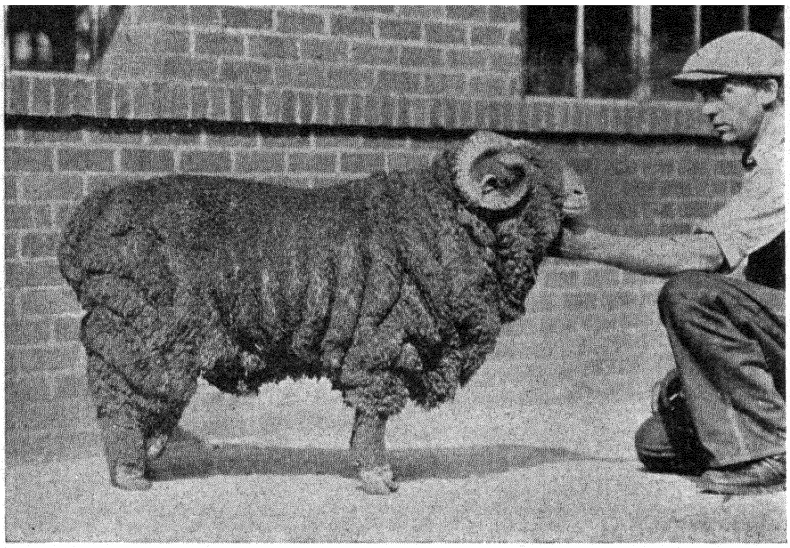
Factors controlling distribution. It is difficult for sheep farming to compete with other types of farming. Wool is not so much of a necessity as are most other animal products, and since it is more durable and valuable, it can be produced much farther from market than the other products. Sheep, which are better adapted to semiarid and rugged regions than almost any other animal, may be fattened on grass alone to better advantage than other animals. They can never be grazed successfully on the same

pasture with cattle, because they bite the grass off so short that nothing is left for the cattle. These influences combine to crowd sheep raising to the marginal lands where population is sparse and other possibilities are limited. A few sheep are economical to grow on the average farm because they can live on products that would probably go to waste otherwise. Since, however, they are subject to disease, require considerable care, and will not protect themselves against predatory animals, many farmers do not care to bother with them.

Regions of production. Sheep are important in all sections of the country, except the cotton belt, many parts of the dairy region, and most sections of the Great Plains. The climate of the cotton belt is too warm, and in the dairy region, where the climate is somewhat too moist, sheep would compete with dairying for labor. Over the greater part of the Great Plains they cannot compete successfully with crops or cattle grazing. Two thirds of the sheep of the country are raised in the dry and the mountain states of the West (Fig. 95). Texas has 15 per cent of the nation's total, practically all of them being in the Edwards Plateau. Montana has about half as many as Texas, and all of the Western States except Washington have large numbers. The sheep of the West are largely of the dual-purpose type. Normally about 55 per cent of the return is from the sale of fat animals and animals to be fattened, and 45 per cent from the sale of wool. The animals are grazed on the ranges in large herds, in many cases in the high mountain meadows during the summer and on the low desert meadows during the winter. Since sheep are usually fed during the winter months, important centers of sheep production are generally found near the irrigated areas where alfalfa is grown.

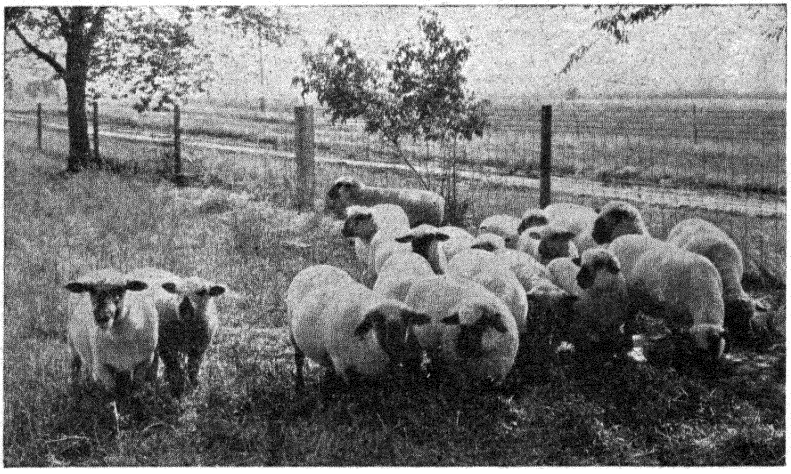
In recent years many farmers have begun to keep flocks on irrigated farms. They graze along the canal banks, utilize surplus roughage, and return considerable fertility to the soil. On some of these farms purebred mutton types are raised, and males are sold for breeding purposes to the growers on the range.

The majority of the sheep in the East are produced in an area



U.S. Dept. of Agr.

Fig. 99. A merino sheep.



Extension Div., U. of Illinois.

Fig. 100. Sheep of the mutton type on an Illinois farm. Note the high fence with barbed wire at the top.

around the eastern end of the corn belt, extending from the blue-grass region of Kentucky to central Michigan. The animals are largely of the mutton type, the Shropshire being the leading breed. Lambs are grown to be marketed, usually at 6 or 7 months of age,

but on the lake plain in New York, where bean straw supplies a part of the feed, and in a few places in Ohio a specialty is made of "hothouse" lambs—those born in the late autumn and early winter and marketed between Christmas and Easter. In the East, where the animals are kept in small flocks on the farms, wool returns about one third of the cash received. On many farms the cost of production is less than on the range because the sheep are more or less a by-product. Where they can be protected against predatory animals, they are economical to raise because they need but little care during the busy season, and they like and will eat types of forage that other animals do not like.

The United States, with about 50 million head, ranks second among the countries of the world in the number of sheep, having about 7 per cent of the total number; Australia has about twice as many.

GOATS

Angora goats are produced chiefly for their hair. When this is no longer of the best quality, they are butchered.

Goats are primarily browsers, living on brush and shrubs. On account of this they have been used to clear land, often preceding sheep in a region. By destroying the low growth they permit the sheep forage to grow. In the Willamette Valley in Oregon they have been used to clear the undergrowth from cutover land. Some ranchmen in Texas first graze cattle over the land, then sheep, and lastly goats, in this way making a complete utilization of the growth. If goats are grazed on permanent ranges, rotation of pastures must be followed, because goats strip the brush in its period of growth.

The herds may be turned into a fenced pasture or herded in small flocks by a caretaker. The industry is more hazardous than sheep growing because of the delicacy of the animals, especially the young. The expenses at kidding time are heavy, and the total costs are higher in the United States than in other countries.

Less capital is required to start in the industry, however, than in sheep growing.

HORSES AND MULES

Requirements of a good draft animal. The chief qualities of a good draft animal are intelligence, agility, strength, and endurance. The horse comes nearest to being the perfect draft animal. It is usually employed only for draft purposes, representing a relatively high standard of living in the groups that use it; poorer people are often compelled to use other animals to obtain power, as, for example, the cow, from which several products may also be obtained. The horse is the luxury draft animal; those groups which have its services stand at the top in the scale of progress.

Climate largely determines the distribution of the different kinds of draft animals, while the distribution of any one kind generally reflects the demand for power. Some places, however, grow surplus animals to sell to other regions. The type of crops, furthermore, has an important influence on the number of draft animals found in any particular section. Intertilled crops, such as corn, would require many more than would a region of equal size which grew wheat or any of the related cereals. In the United States the greatest numbers are found where the acreage in crops is greatest. The South has as many acres in crops per work animal as has the corn belt but has fewer acres proportionally in crops.

In the United States both mules and horses are used for draft purposes. Mules are found largely in the cotton belt and horses in the other parts of the country, but recently mules have been increasing in favor in the regions where horses predominate. Perhaps, since there was no money to be made in the growing of surplus horses for sale, the farmers have turned to mules for reasons of economy: mules are stronger than horses and can subsist on coarser forage and less of it. They have always been used in the cotton belt because of the warm climate and the type of farming,

and because they could stand the rough treatment given by the Negroes. A horse has too nervous a disposition to stand rough treatment.

Surplus draft horses have been raised chiefly in the grain belt, where there is cheap grain and forage, and where the seasonal distribution of work provides rest periods for the mares. The chief breed of draft horses is the Percheron, native to France. All of our draft breeds are native to either the British Isles or Europe.

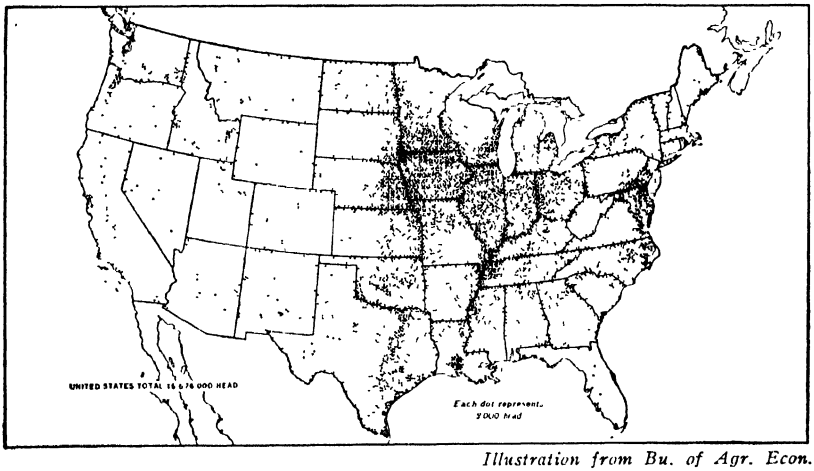


Illustration from Bu. of Agr. Econ.

Fig. 101. Horses, mules, and colts of all ages, Jan. 1, 1935.

In this country they have been bred to have more agility and a faster walk than in their native lands. The centers of mule production are about 300 miles south of the centers of horse production. The warmer climate and the market for mules in the cotton belt are responsible for this. A large part of the mule-producing section has a smaller proportion of cultivated land than the grain belt, and more pasture. Formerly Tennessee and Kentucky were the leading mule-raising states, but now, because of cheap feed, Missouri, Kansas, Oklahoma, and Texas raise most of the supply.

The introduction of the farm tractor has resulted in a decline of about 40 per cent in the number of draft animals since 1920. Be-

tween 1910 and 1930, the amount of animal power on the farms decreased 18 per cent, while the amount of mechanical power increased 715 per cent.[1] The earlier tractors were more economical on the larger farms, but since 1930 improved types have been made for both large and small farms. This decline in the number of draft animals has released for other purposes from 30 to 45 million acres of land that were formerly used to grow feed crops. On account of the depression, the use of draft animals has been increasing, and their prices have been high. High prices will prevail until a greater number can be bred. Temporarily, farmers may, therefore, buy more tractors. It remains to be seen which type of power will ultimately predominate.

POULTRY PRODUCTS

The efficiency of poultry. There are few products today that are so widely consumed as are eggs and poultry meat. Like dairy cows, poultry are efficient food producers. Since they are foragers, they utilize a large amount of waste products by obtaining a part of their living from grass and insects and from grain and miscellaneous products which otherwise would go to waste. Poultry also utilize a small amount of labor efficiently, bring in a return nearly every month of the year, contribute an essential part to the diet of the farm home, and may be sold or killed on the farm when their egg-producing days are past.

One ordinarily thinks of eggs as the chief product from poultry, but in the United States the meat represents about 42 per cent of the total value of all poultry products. Eggs, 97 per cent of the edible part of which is digestible, are high in protein content and contain most of the elements required by the body.

Influences locating poultry production. Since poultry, like swine, are scavengers and are able to utilize a variety of feeds, they are widely grown. Figure 102 indicates both that nearness to supplies of feed and nearness to market are the major factors in locat-

[1] See *General Conditions and Tendencies Influencing the Nation's Land Requirements*, Part I of the Report on Land Planning to the National Resources Board, p. 40.

ing the commercial poultry industries, and that a favorable climate, such as that of California, whose eggs compete successfully in the eastern markets, may also have considerable influence.

Types of poultry industry. There are three general types of poultry flocks: (1) farm, (2) back-yard, and (3) commercial. The production of the last-named type may be subdivided into (1) the production of breeding animals, (2) the production of eggs for hatching purposes, (3) the production of market eggs, (4) the production of young fowls for meat, and (5) the production of young chicks in hatcheries to be sold to those maintaining flocks. Of these divisions, the third is probably of most importance in so far as value of the product is concerned. The location of the producer with respect to the market, shipping facilities, and the volume of production are important in determining which type of production is followed. The development of the hatchery business has caused an expansion of the poultry industry in recent years because it removes the burden of hatching (which requires much labor and care) from many shoulders and places it on a few specialists.

Regions of production. Three poultry sections may be distinguished: (1) the Northeastern States, (2) the Pacific Coast States, and (3) the grain states of the Mississippi Valley. In the first two sections the industry has become specialized, and poultry farming is of major importance in the agricultural systems. Many small farms are devoted entirely to commercial poultry farming. In the Northeast a typical poultry farm consists of about five acres and maintains about 1,500 hens, chiefly White Leghorn. Since the White Leghorn and other egg-laying breeds are native to the warm, dry Mediterranean type of climate, the cool, damp climate of the Northeast makes necessary expensive housing to avoid disease.

Though California is remote from the great eastern markets and must pay more than the other sections for cereal feeds, it has the advantage of favorable climatic conditions and an abundance of green feed the year round. As with other products from the

west coast, coöperative marketing associations are an important factor in marketing. These associations study their markets and supply them with a standardized product of dependable quality.

The central region produces large quantities of eggs and meat on the grain and stock farms, but the industry is of minor importance in the system of farming. Not much specialization has taken place except near the larger cities. The industry tends to specialize as agriculture becomes more intensive.

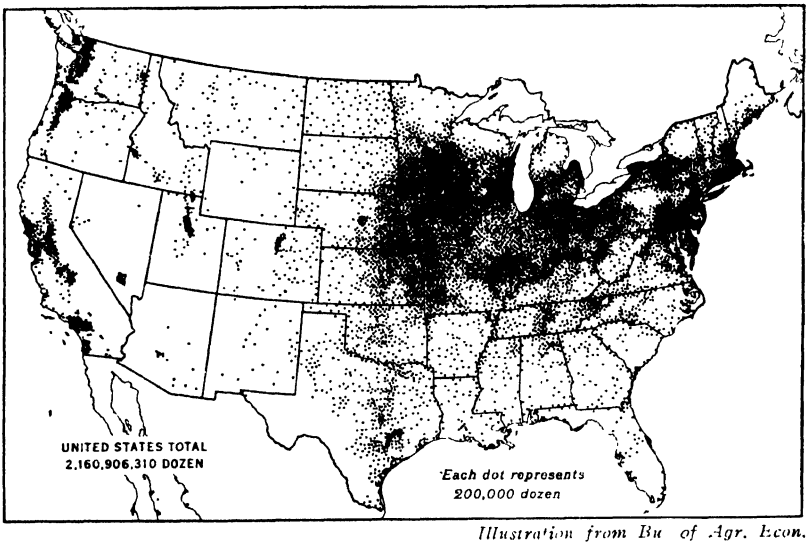


Illustration from Bu of Agr. Econ.

Fig. 102. Eggs, production, 1934.

Poultry are scattered throughout the remainder of the country, but the industry has received little attention. About 90 per cent of the farms of the country keep poultry, which are increasing in favor because of the efficiency of their production and the relatively stable income which they return.

Poultry packing. Poultry, both alive and dressed, is shipped for meat purposes to large cities and the eastern markets. The greater part shipped is dressed. Most dressed poultry comes from the packing establishments of the Middle West. These plants are located in the larger cities, which are poultry concentration points for a large area. Often they maintain fattening yards in which

substandard fowls are kept until ready for killing. Because poultry meat is very perishable, it must be kept under refrigeration until sold. Large amounts are put in cold storage and kept for a considerable length of time. The latter half of the year is the chief period for packing. New York, on account of its large Jewish population, has an important poultry-packing industry.

FOREIGN COMMERCE IN ANIMAL PRODUCTS

Our once important exports of several animal products, which had been declining rapidly since 1920, have all but disappeared since 1929. Drought, depression, and agricultural programs have been contributing factors, but the expansion of animal growing in several foreign markets and the increasing use of vegetable oils have been fundamental influences. We are also consuming an increasing amount of these products at home, and, because of the relative decrease in meat production as more intensive methods of farming become necessary, the increase in meat production has not kept pace with the growth in population. Lard has always been one of the most important exports among animal products, and it is now declining, although it did hold up well until the past few years. Previous to 1930, 50 per cent of our lard was exported; in 1937 only 8 per cent. In the latter year our exports of meat products were $43,000,000, which was only 20 per cent of the 1926-30 average; two thirds of these exports were meats and one third was fats. Previous to 1929 half of the total was lard. In 1937 the United Kingdom took about half of the exports, and Cuba and our foreign possessions most of the remainder.

Normally we import small amounts of fresh meats and live animals from Canada and Mexico, canned beef from Argentina, and cheese from several countries.

17
IRON AND STEEL

THE discussion of the animal industries closes on those enterprises in the United States which provide raw materials and foodstuffs. Only a small proportion of the output of these commodities may be consumed directly; processing or manufacturing operations are necessary to prepare the remainder for use. Consequently, attention is now directed to those major manufacturing industries which fashion various intermediate and final goods from the products of forest, mine, and farm. The most fundamental of these industries is the manufacture of iron and steel.

Rise of iron and steel industry in the United States. For many years the United States has held foremost place in the iron and steel industries of the world. This position is still retained, although by a somewhat smaller margin than formerly, as indicated by a drop from 50 per cent of the world total in 1926 to 30 per cent in 1936.

Growth of the industry since the Civil War should be noted. This period has been one of great internal development, but the discovery of the Bessemer and of the open-hearth processes for making steel made this development possible. Early railroad building required cheap steel in large quantities, and this was made possible by the Bessemer process. As the weight of railroad equipment increased, a better quality of steel than could be made by the Bessemer process—since this steel contains defects and may break without warning—became necessary. The open-hearth process solved this problem. At present the products of the iron and steel industry comprise 12 per cent of the freight tonnage of the railroads of the country. So important is the steel in-

dustry in our economic life that its output is one of the important business barometers employed by businessmen. More than $4\frac{1}{2}$ billion dollars are invested in the nation's iron and steel industry, which has a normal output of more than 3 billion dollars and employs almost 600,000 workers.



American Iron and Steel Inst.

Fig. 103. Per capita use of steel.

Divisions of the industry. At least 14 distinct industries can be identified as subdivisions of the iron and steel industry. They make 500 separate products in as many as 100,000 different sizes, shapes, and finishes; and most of these products have several uses. The divisions of the industry as given by the Iron and Steel Institute "are those which produce merchant pig iron, tool steel, wrought iron, products rerolled from discarded rails and axles, pipe and tubing, sheet steel, cold-rolled strip steel, cold-drawn bars, tin plate, wire and wire products, steel castings, steel forgings,

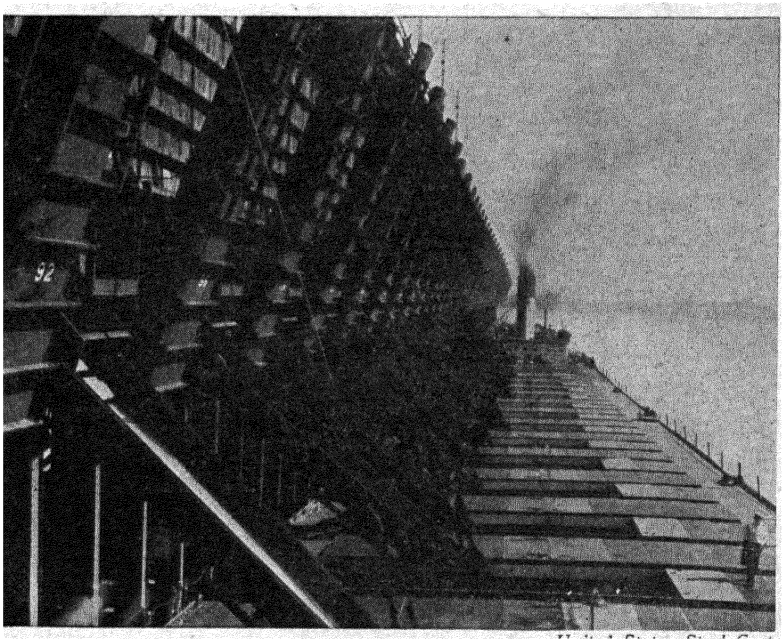
bolts and other fastenings, coke and its by-products." A brief statement will be made concerning the more important products of each division.

Merchant pig iron is produced for sale to manufacturers who do not own blast furnaces, and to foundries. The tool-steel division manufactures high-quality steel for sale to toolmakers and manufacturers of products requiring it. Wrought iron is used largely for pipe. The rerolling industry rerolls old rails and railway-car axles into new light shapes, an important type being rods for reinforcing concrete. Steel pipe and tubing are used for pipe lines and plumbing. Sheet steel is made into such products as automobile bodies, roofing, and culverts. Cold-rolled strip steel is used in the manufacture of business machines, automobiles, and machinery. Tin plate is used largely in the canning industry, but also for toys and kitchenware. Woven and barbed wire, nails, and springs are the main products of the wire division. Some foundries cast steel into rolls for rolling mills and into parts for heavy machinery. The manufacturers of forged products make heavy articles, such as shafts, axles, and oil-refinery equipment. The uses of bolts and other fasteners—spikes and screws—are obvious. Large companies usually make their own coke and may have a surplus to sell as well as various by-products resulting from the manufacture of the coke.

Transporting the iron ore. In Chapter 4 it was stated that 85 per cent of our supply of domestic iron ore was mined in the Lake Superior district. Before most of this ore can be used, it must be transported by boat to the lower Lake region, where it meets the fuel to smelt it, and where the principal markets for steel products are easily accessible. A year's supply of ore must be transported in 8 months, because the Lakes are closed by ice for 4 months. The transportation of the iron ore is then an important step in the manufacture of steel.

After the iron ore comes from the mine, it first passes through a screening plant, which removes large rocks, and then through a crushing plant, which crushes the larger chunks. It is now

loaded onto trains and hauled to the docks at or near Duluth, each train carrying about 2,500 tons. Normally about 30 trains per day are required at the Mesabi range. At the ports the cars are run onto unloading piers and tipped, the ore running into pockets in the pier. One of the largest piers at Duluth is about three eighths of a mile in length and contains 384 pockets, each one having a capacity of 400 tons.



United States Steel Corp.

Fig. 104. Ore boat loading from pockets of pier at Duluth.

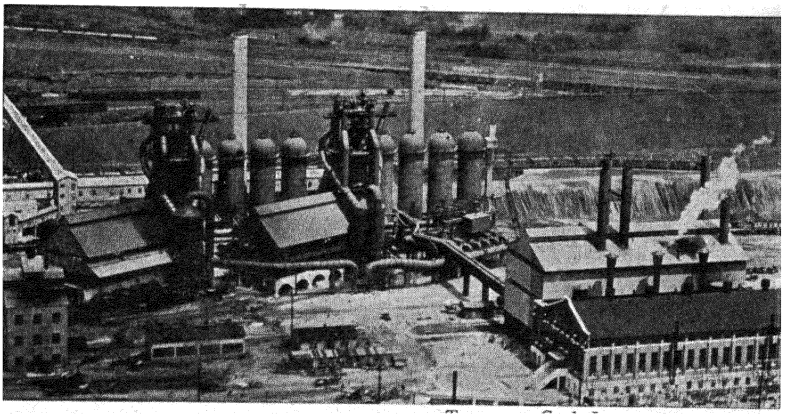
The ore is loaded into the boats by gravity through electrically operated spouts. The boats, which are about 600 feet in length and of 13,000 tons capacity, are simply huge metal shells. Not all smelting furnaces are equipped to utilize ore with the same impurities or the same proportions of given impurities. Consequently, the boats are loaded from many different pockets, since the ores from the different mines vary as to the type and amount of impurities. The contained impurities are determined from samples taken from each car before it leaves the mine. At the lower

Lake ports, the ore is unloaded either into the storage bins of the manufacturer or onto trains to be taken to the inland smelting centers. Unloading is done with electrically operated equipment similar to a steam shovel, and a boat can be unloaded in less than a half day. All of the work connected with the transportation of the ore is done with large-scale equipment, reducing the time and labor requirements to a minimum. The resulting costs are very low. During the 8 months of operation an ore boat makes from 20 to 25 round trips, the distance from Duluth to either Chicago or Cleveland being roughly 825 miles. The average time for loading a boat is about 9 hours, and, for unloading, about 20 hours.

Stages in the manufacture of iron and steel. There are 3 stages in the manufacture of iron and steel products: (1) the production of pig iron, (2) the production of steel, and (3) the production of finished shapes. Another process, the making of wrought iron, should be noted. Steel is usually made directly from the pig iron, but pig iron may be refined into wrought iron for commercial use. In the refining of pig iron and the manufacture of steel, the stage of wrought iron is reached but is of no separate importance, because the process is continuous. Steel is wrought iron with carbon and alloys added to it. Before the discovery of the processes for making steel in large quantities, wrought iron was the principal form in which iron was used. The present production is 3 per cent of that of steel. The principal assets of wrought iron are its resistance to corrosion and to fatigue, the former owing to the fact that it is 99.84 per cent pure iron and to the small amount of slag which it contains. It is used mainly for pipe, chain, sheet iron, and blacksmith's bar iron, being desirable for chain because it will stretch and stiffen before breaking. Although there are mechanical methods for making wrought iron, it usually is made by the puddling or stirring process, which is expensive because of the large amount of hard work that is required.

Pig iron is made in the blast furnace (Fig. 106), where the iron is freed of most of its impurities. Coke, iron ore, scrap, and limestone, weighed and handled automatically, are fed in at the top of

the blast furnace, and air, preheated in the stoves to about 1,250° is forced in at the bottom. Most iron ores are oxides, and the problem involved in smelting is to separate metallic iron from the chemically combined oxygen. The heated air ignites the fuel, gradually melting the charge, while the resulting gases remove the oxygen from the ore, reducing it to iron, and the flux causes the earthy matter to separate into slag. The proportions of coke,



Tennessee Coal, Iron and Railroad Co.

Fig. 105. Blast furnaces at Birmingham, Alabama. Elevated chute brings coke from coke plant. Building on right is power house.

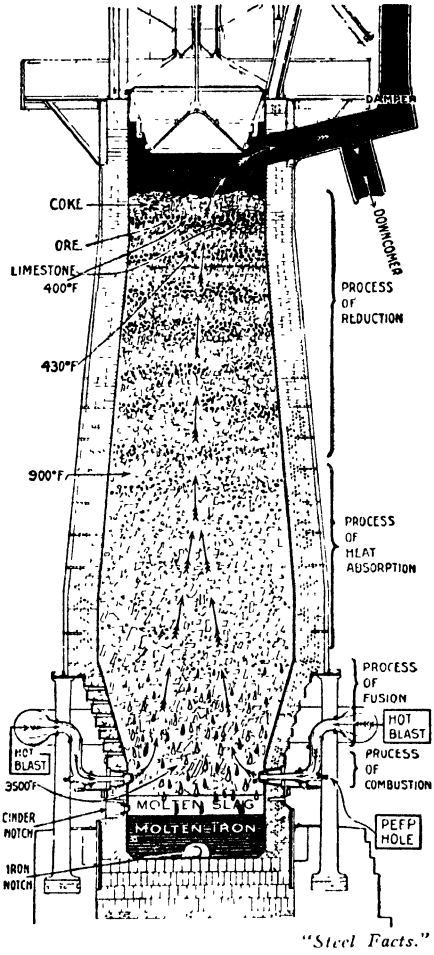
iron ore, and limestone vary according to the nature of the ore and the uses for which the steel is intended, but

> . . . to produce one ton of pig iron requires on the average 1.7 tons of iron ore, 0.9 tons of coke, 0.4 tons of limestone and 0.2 tons of cinder, scale, and scrap, as well as about 4 tons of air. In addition to the pig iron the furnace yields about one-half ton of slag and about 6 tons of gases per ton of pig iron produced.[1]

After the pig iron is drawn, the blast furnace being tapped every 4 or 5 hours, it may be carried to the next process in the molten state, or it may be cast into bars (pigs) of about 80 pounds each. Pig iron may be made directly into some products, but for most purposes it must be further refined. It may go to the foun-

[1] *Steel Facts*, Dec., 1936, published by the Iron and Steel Institute, New York, p. 7.

dry to be made directly into cast iron, to the puddling mill to be refined into wrought iron, or to the Bessemer converters or to open-hearth furnaces to be converted into steel. A large blast furnace can produce as much as 1,000 tons of pig iron in 24 hours.



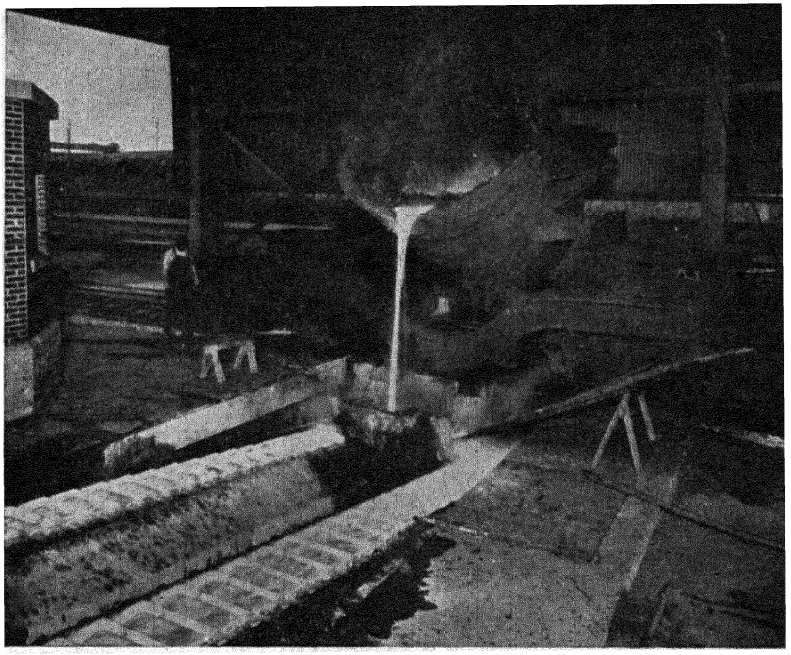
"Steel Facts."

Fig. 106. How the blast furnace operates.

Pig iron is made into solid bars (pigs) for sale to independent foundries and for storage when the steel-manufacturing divisions of a large mill are idle or working only part time. The work is now done by a machine which conveys an endless chain with re-

ceptacles past the ladle which contains the molten iron. Originally the molten iron was poured into troughs made of sand.

Pennsylvania and Ohio each produce about 25 per cent of the nation's pig iron, Illinois and Indiana each about 10 per cent, and Alabama and New York each 7 per cent.

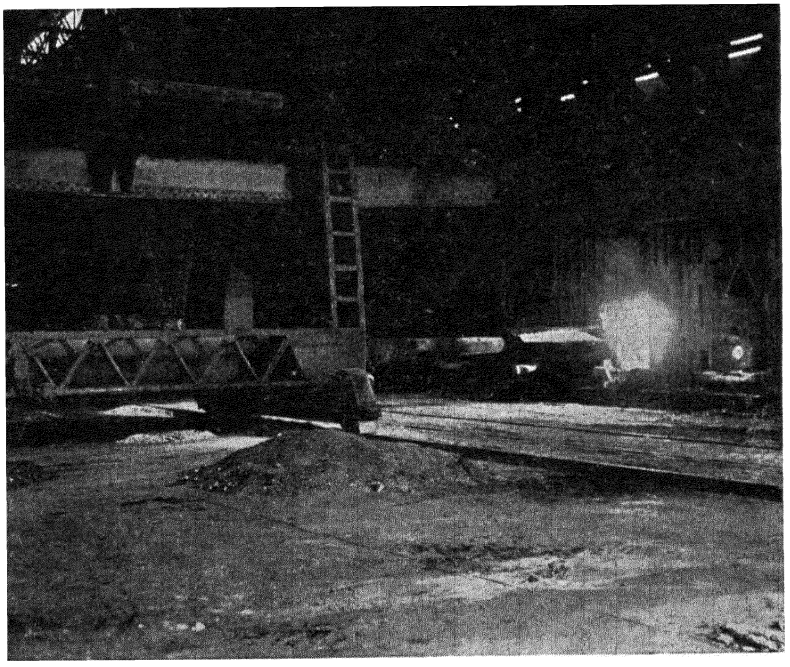


Tennessee Coal, Iron and Railroad Co.

Fig. 107. Pig-casting machine.

Steel may be made, as stated above, in either a Bessemer converter or an open-hearth furnace, or in an electric furnace, or by the crucible process. The last is declining in importance. The electric furnace is expensive to operate and can produce only a small amount at one heat. Bessemer steel has defects, as has been stated. Open-hearth processes are controlled automatically, which gives careful control over the quality of the steel. This has resulted in about 90 per cent of our steel being made by this means. Bessemer steel, however, is used for such products as pipe, wire, and screws. The method employed depends upon the nature of

the iron ore or the product which is to be made of the steel. There are two Bessemer processes, the acid and the basic, the former adapted to ores of low phosphorus content, the latter to those with a high phosphorus content. There are likewise an acid and a basic open-hearth process, which can utilize a wide range of in-



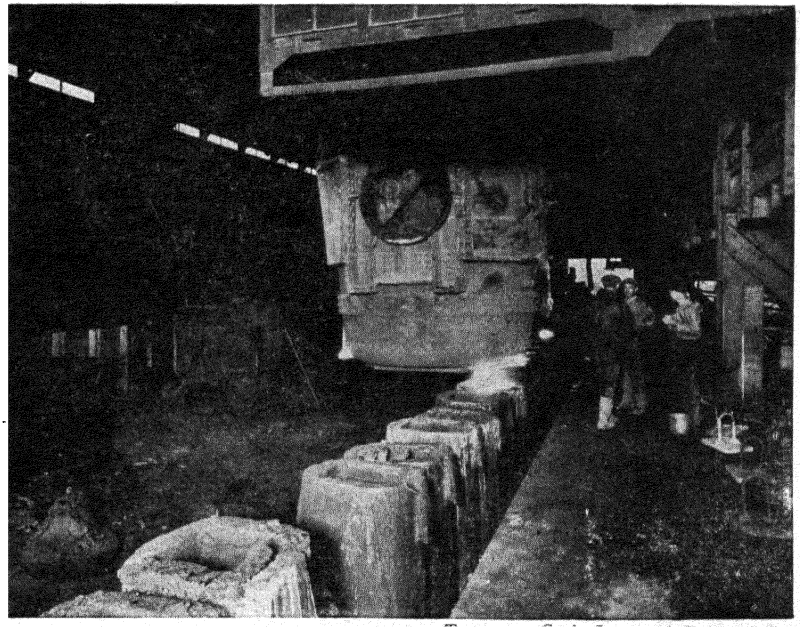
Tennessee Coal, Iron and Railroad Co.

Fig. 108. Charging open-hearth furnace.

termediate types of ore. Steel products of a high quality and alloy or special steels are usually treated first in an open-hearth furnace and then finished either by the electric or the crucible method.

In addition to making better steel, the open-hearth furnace is more economical to operate than the Bessemer converter, and can also utilize scrap. Since most steel is made by the open-hearth process, only that one will be described.

The essential principles involved in steel manufacture are (1) the removal of the impurities in pig iron and (2) the addition of such alloy metals or minerals as may be necessary to give the resulting steel the qualities desired. First, scrap steel and limestone are put into the furnace and melted at a temperature of 3,000

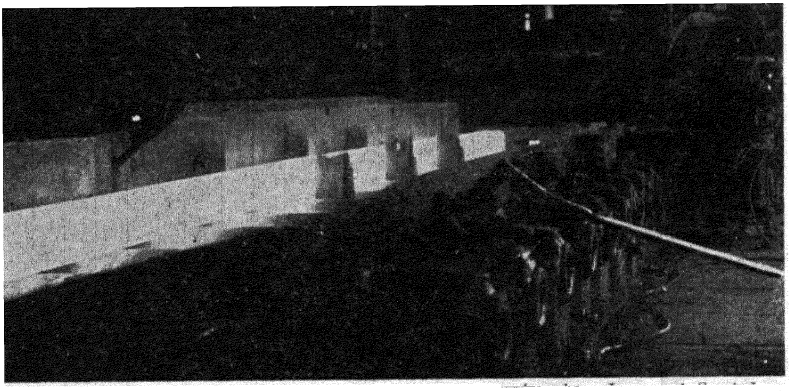


Tennessee Coal, Iron and Railroad Co.

Fig. 109. Pouring molten steel into ingot molds.

degrees, the limestone serving the same function as it did in the blast furnace. Next, the molten pig iron, which has been brought from the blast furnace in large ladles by special railway cars, is added along with any necessary alloys. Tests are made frequently to determine when the steel is of the right chemical composition for the process to be stopped. When the steel is ready to be drawn, a clay plug is knocked out with a long bar and the molten material flows into a large ladle. The slag drains into a smaller ladle. Other necessary alloys are added to the steel in the ladle.

The next step is to pour the molten steel through an opening in the bottom of the ladle into forms 6 by 2 by 2 feet, called ingot molds, each one holding from 10,000 to 15,000 pounds of metal. These are arranged in rows on railway cars, and a crane carries the ladle along the row of molds. After the metal has hardened, the molds are stripped off and the ingots of steel are placed in a soaking pit, where a gas flame keeps the proper temperature on the surface until a uniform temperature of 2,200° throughout is obtained. When cooled uniformly throughout, the ingots are



American Iron and Steel Inst.

Fig. 110. Rolling of ingots.

ready to start through the final processes which convert them into the various finished products demanded by the market.

In finishing, the hot ingots first go to the blooming mill, a reversing mill where the ingot is run back and forth between rollers and made into a short thick slab called a bloom. This process is similar to the kneading of dough, and is done for the same purpose. The blooms then go to other departments, where they are shaped into such products as rails, sheets, and structural steel.

Use of water. People are not usually aware of the amount of water necessary for the manufacture of steel. The Iron and Steel Institute has estimated that 4 billion gallons are used daily, an amount greater than the daily consumption of New York City. Only Boulder Dam could store this amount, and it has only 7

times that capacity. The raising of steam requires 45 per cent of the water used. Cooling the furnace doors and rolls, washing away the scale which forms in rolling, and the operation of hydraulic machinery require 29 per cent. The cooling of the blast furnaces takes 20 per cent, the quenching of the coke as it comes from the oven 6 per cent, and sewage the remainder.

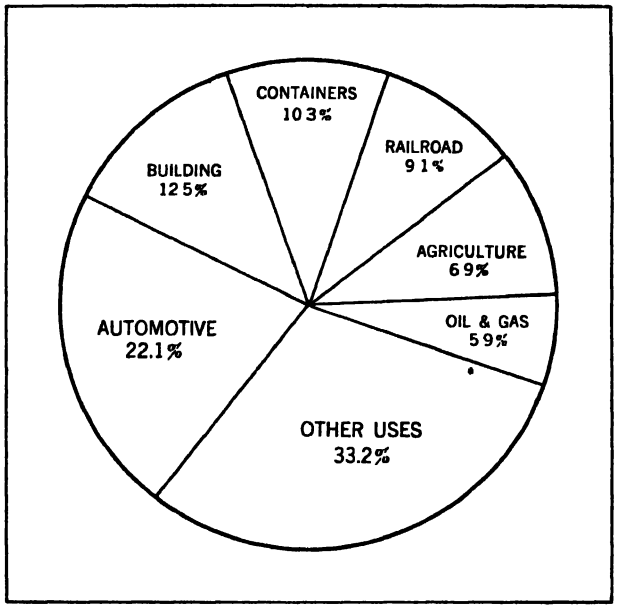
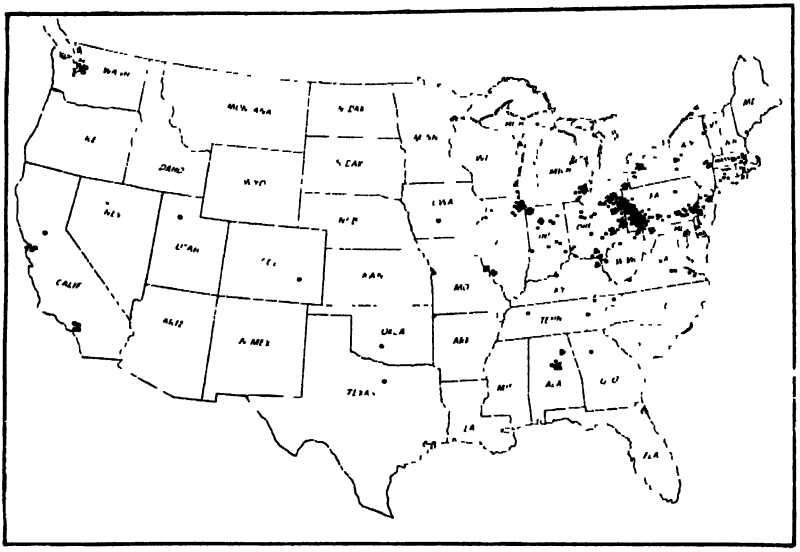


Fig. 111. Leading uses for steel in the United States in 1936.

Organization of steel manufacturing. Large, completely integrated companies prevail in the steel industry. Small companies are usually engaged in making special products, which, incidentally, are of growing importance. The description of the steel-manufacturing processes made it evident that hand labor has little place in a steel mill except for supervision and adjustment, but even these activities require a large number of workers. The nature of the processes, the great quantity of hot material which must be handled in large masses, the great amount of machinery necessary, the importance of fuel, the necessity of continuous proc-

esses, the use of by-products, and the need for continued scientific research make it economical to do the work in large plants.

Large companies, however, do not concentrate their entire production in a single plant but have mills scattered over the country at places where the conditions for making steel are favorable, each mill tending to specialize in the products demanded by its market area. There is also a tendency toward specialization by



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Fig. 112. Location of iron and steel mills

plants if a company has more than one mill in a given area. Much of the recent expansion by companies in the industry has been by building new plants in rising market areas rather than by enlarging the existing plants in the older centers.

Location of iron and steel factories. Figure 112 shows the distribution of iron and steel mills over the country. Several distinct centers may be identified. Pennsylvania has about 35 per cent of the total capacity. Factors which locate the industry are large supplies of iron ore, available coal at low cost for smelting and for power, ready accessibility to markets, the inertia of existing centers because of the great investments of capital, the immo-

bility of labor, price policies ("Pittsburgh plus"),[2] the degree of integration prevailing in the individual companies, the freight-rate policies of the railroads, and supplies of capital and men of technical and organizing ability.

Several materials are used in steel manufacture, and it is the combined cost of assembling them, in conjunction with marketing a bulky product, that primarily locates the industry. Usually the iron ore moves toward the fuel, but if there is a market for manufactured products available to the regions producing the ore, the empty ore cars and boats may take a return load of fuel. This accounts for the rise of Duluth as a manufacturing center, and to some extent the Lake Erie cities. Pittsburgh has supplies of fuel and limestone, is at the same time located centrally for markets, and has good transportation to those markets. It also has the advantage gained from its early start. The great investment in factories makes it difficult for the industry to move, and Pittsburgh plus was devised for the purpose of maintaining the dominance of the Pittsburgh district.

At Birmingham the materials are close together, the ore bodies and coal measures being closely associated, and some of the ore contains sufficient lime to be self-fluxing. The city is the center of a large marketing area and has good transportation.

Mesabi ore, Pennsylvania coke, and Illinois coal may be assembled cheaply at Chicago, and the city grew as a steel center because of the westward movement of population and industry and the consequent rise of markets for heavy steel products in that area. The improvement of the Illinois River and favorable rail-water rates on export steel have recently been advantageous factors.

Along the middle Atlantic seaboard the Philadelphia section and Sparrows Point in Maryland have a steel industry based on Pittsburgh coal and imported iron ore, 50 per cent being from Chile, but with Cuba, Norway, and Sweden also contributing sup-

[2] Under this plan steel was sold at the price in Pittsburgh, plus the cost of transporting it from Pittsburgh to the place where it was sold, regardless of where it was made This policy has now been revised.

plies, while plans are in progress to use ore from Brazil. The shipbuilding, machinery, and hardware industries furnish important markets.

Boston has a small steel industry using imported iron ore and the coke which remains as a by-product after the manufacture of gas for domestic purposes.

Another center is along the Ohio River near the junction of Ohio, Kentucky, and West Virginia. The coal of the middle Appalachian field is near by, and iron ore is obtained cheaply in the cars which return from hauling coal to the Lake ports.

St. Louis is growing as a steel center, being centrally located for marketing a variety of products, and obtaining coal from southern Illinois and iron ore from the Ozarks and from Minnesota by way of the Mississippi.

Duluth is near the iron-ore supplies and near a market for such products as rails and mining and farm machinery, and obtains coal on the ore boats returning from the lower Lake ports.

Pueblo, the Pittsburgh of the West, obtains iron ore from Wyoming and coal from southern Colorado and New Mexico, and supplies a local market for rails and mining machinery.

The Pacific coast has no smelting industry of importance but manufactures steel for the shipbuilding and canning industries.

The size of and degree of integration in the plants also influence the location of iron and steel mills. The larger plant has to consider the factors locating an entire industry instead of those applying to only one division. The market for by-products may be an important consideration.

Since iron ore and coal are different types of products, railways may charge rates which will favor the movement of the one or the other, or which may favor the movement of the raw material more than that of the finished product or vice versa, and thus influence the location of factories. Transit privileges, which give the manufacturers the right to a through rate from a manufacturing to a marketing center, but which permit the steel to be unloaded en route and made into the dimensions required by the

market without losing the advantage of the through rate, cause fabrication centers to spring up at distances from the manufacturing centers.

The necessity for good organizing and technical ability should be evident from the fact that steel manufacture is large scale, of a chemical nature, and dynamic.

Steel centers and their products. As was stated previously, the manufacturing centers specialize according to the demand of the particular area. Thus the northeastern district, extending from southeastern Pennsylvania to central Massachusetts, produces more of certain highly finished products, such as wire specialties, springs, cold-drawn bars, and tubing. The Midwest makes the heavier products, such as sheets, structural shapes, steel bars, and reinforcing bars for concrete. Birmingham is relatively more important for iron products than for steel. Pipe and bands for cotton bales are important. The canning industry causes tin plate to be the leading product on the west coast. Pueblo makes steel for mining machinery and for rails.

By-products. The important by-products of steel manufacture are scrap, coal tar and ammonia, slag, and gas. Scrap is saved and used over again. Coal tar may be used for fuel in the open-hearth furnaces or be further refined and the products sold to chemical factories. Ammonia and slag are used to make fertilizer, which is manufactured for the market by the larger companies, while slag may also be used for making brick and cement. The gas is used for fuel in the coke ovens, stoves, and open-hearth furnaces. In 1936 the value of these by-products was about $133,000,000, that of gas being two thirds of the total.

One should note the completeness with which everything is used under the most modern methods. This is the result of scientific discovery, depleted resources of coal, growing markets for some products, and competitive conditions within the industry.

Foreign commerce in iron and steel products. Only four or five per cent of the products of our iron and steel mills are exported, but a much larger quantity reaches foreign countries in

the form of engineering products—machinery and equipment—for which the market has recently been growing. Canada purchases almost half of the total, and is followed by Mexico and the Caribbean countries. Small amounts go to China and the U. S. S. R. The leading products are structural shapes, pipe, tools, wire, and tin plate and terneplate. There is also a considerable export of scrap steel, in recent years almost half going to Japan and the remainder largely to Italy and the United Kingdom. In exporting steel to several markets, we are at a disadvantage compared with several of the countries of Europe, because their steel centers are located more favorably for marketing by water than are ours.

Imports of steel, largely from Germany, Sweden, Belgium, and Great Britain, are about 25 per cent as valuable as the exports, and consist mostly of superior specialized products.

18

TEXTILES

AFTER food, clothing, either for protection against the elements or to satisfy the conventions of society, is man's most urgent need. Various vegetable and animal fibers, chiefly cotton and wool, but also silk, flax, rayon, and others have been used for the purpose. In the early stages of progress man's clothing is cheap and crudely made. As he progresses, he requires a greater quantity of clothing and prefers more costly types.

Clothing, of course, is not the only product made from textile fibers. Cotton fabrics are made into many industrial products, among which are sacks, wrapping materials, tire cords and fabrics, and even fabrics for reinforcing concrete highways, the cotton being placed over the stone base before the concrete is poured on it. High-grade fabrics, made with utmost care, are among the principal necessities for the manufacture of balloons, airplanes, and dirigibles.

Distribution of manufacture. Textile factories are widely scattered because of (1) universal demand, (2) wide distribution of the raw materials, (3) work which permits the use of woman and child labor, (4) the simple nature of and ease of learning the processes, (5) the relatively small amount of power required, and (6) the adaptation of the industry to small-scale methods, there being little economy in large plants because of the nature of the machinery and the processes. The profitableness of small plants also makes it possible to start factories with the financial resources of a single individual or a few individuals.

In the United States textile manufacturing is found throughout the Appalachian highland from southern Maine to central

Georgia, Alabama, and Mississippi, where the highland meets the coastal plain. There are also plants in the Midwest and a growing industry on the Pacific coast. The Appalachians are near large markets and have abundant water power and easily available coal. With limited agricultural opportunities, the people of the region have welcomed a chance to leave the highland farm for the factory. There are, furthermore, several centers of heavy industry where woman and child labor may be obtained.

New England is important for both cotton and woolen manufactures. Philadelphia is a leading woolen center; between that

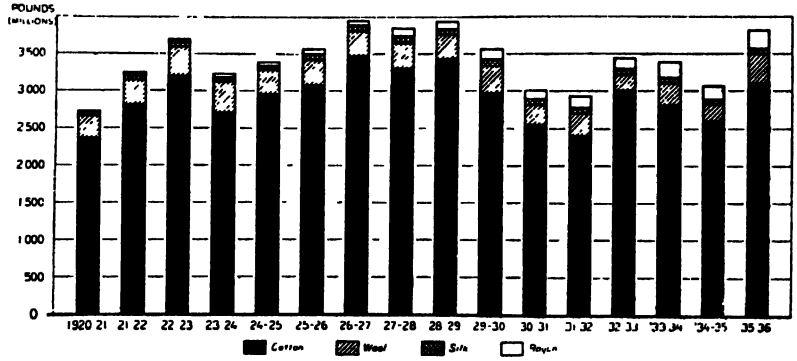


Illustration from Bu. of Agr Econ.

Fig. 113. Consumption of cotton, wool, silk, and rayon, United States, 1920-21 to 1936.

city and the New England area are the silk industry of Pennsylvania and New Jersey and the finishing industries of New Jersey. The southern Appalachians manufacture chiefly cottons, while northward is the rayon industry of Virginia, Pennsylvania, West Virginia, and Tennessee.

The manufacturing processes. Textiles are manufactured largely with automatic machinery, the worker's function being chiefly to supervise the machinery and make adjustments. Four steps may be recognized: (1) the preliminary operations, (2) spinning, (3) weaving and knitting, and (4) finishing. The manner in which these processes are carried out varies with the different fibers, but they are essentially similar and therefore will be described briefly at this point. Their application to the various fibers is described later in this chapter.

In the preliminary operations foreign matter is removed, and the fibers are prepared for the spinning machine.

Spinning consists essentially in straightening the fibers and drawing them out into a continuous thread or yarn.

In weaving there are two sets of threads, the warp, composed of parallel threads, and the weft, or woof, running crosswise of the warp. Weaving consists in passing the weft over the odd and under the even warp threads, and then reversing the order.

In knitting only a single thread is used. Loops are made in it, and one series of loops is drawn through the preceding one.

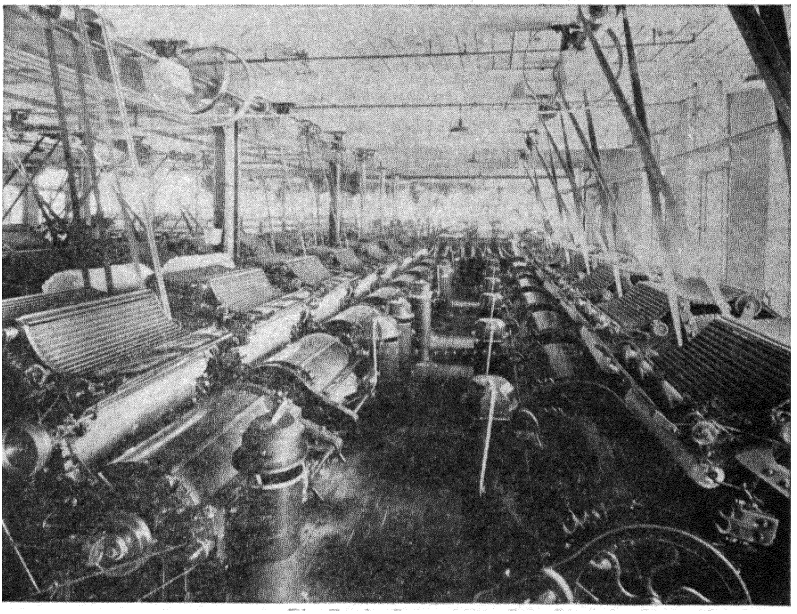
Finishing consists of bleaching, dyeing, printing, and of other operations necessary to prepare the woven or knitted material for the market.

These operations may all be done in the same plant; or in the case of small companies, there may be independent ownership of each of the steps, or there may be a combination of two of them. Wool scouring and various finishing operations may be done in separate plants, often very small. Many plants spin yarn and sell it to weavers and knitters who may do nothing but weave or knit. To a considerable extent finishing operations are independent of the others. One reason for this is that one finishing plant can handle the output of several weavers or knitters. Certain companies keep in close touch with the market, finishing to suit a particular demand. New Jersey is important in finishing because it is located between two great textile-manufacturing areas, manufactures a great deal itself, and is near the New York market, the leading single market for fabrics in the country.

COTTON

Manufacturing operations. The first step in manufacturing cotton is the breaking of the bales with a machine, after which other machines carry the lint along and remove the coarser particles of foreign matter. The lint then goes to the carding machine, which removes small pieces of foreign matter, separates the individual fibers from the matted mass, and puts them in a

long continuous sheet. This sheet is then passed through a funnel, which unites the fibers into a large, loose strand called a *sliver*. The slivers in turn are passed through the drawing machine, which draws out the fibers and makes them parallel. Other machines reduce the diameter of the sliver and give it the desired twist, leaving the yarn ready to be woven. The essentials



The Erwin Cotton Mills Co. Photo by James Huntington.

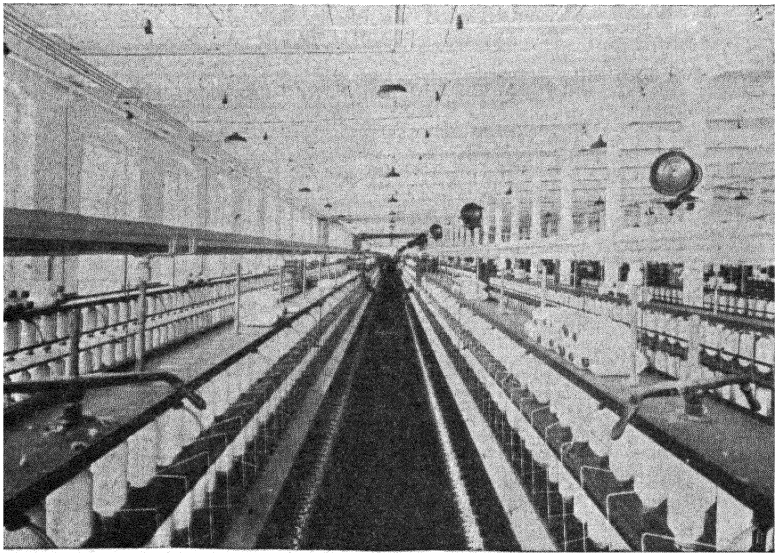
Fig. 114. View of card room showing cotton being processed through the cards and, in the background, through the drawing frames. The metal cylinders contain the slivers.

of the weaving and knitting processes have already been given. Cotton is the leading fiber for both weaving and knitting.

After weaving, the gray cloth, as it is then called, must go through various finishing processes. It is first brushed by a machine to remove impurities and then subjected to fire to burn off the lint, after which it is bleached with chemicals. If the cloth is to be white, it is starched and ironed and rolled into bolts; if it is to be dyed, it is first mercerized in a solution of caustic soda.

Centers of manufacture. Four centers of cotton manufacture may be noted: (1) southeastern New England between south-

western Maine and southwestern Connecticut, but centering chiefly in the Narragansett Bay and Merrimac River districts, (2) the Mohawk Valley, (3) the Carolina Piedmont, centering at Charlotte, and (4) a belt along the southern edge of the Appalachian highland, particularly along the Fall Line in Alabama and Georgia. The latter region is youngest and is gradually ex-



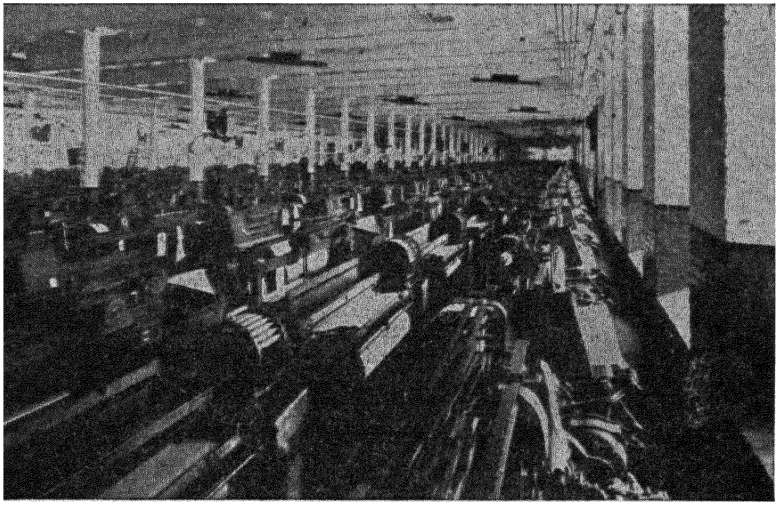
The Erwin Cotton Mills Co. Photo by James Huntington.

Fig. 115. Spinning room in a cotton mill.

tending westward, where cheap hydroelectric energy should aid in its expansion. The following figures show, for the several states, the number of spindles and the quantity of raw cotton consumed for the year ending July 31, 1938, and the value of the product for 1935:

State	*Number of Active Spindles*	*Bales of Raw Cotton Consumed*	*Value of Product*
South Carolina	6,049,000	1,478,000	$233,737,000
North Carolina	5,731,000	1,196,000	177,883,000
Massachusetts	3,766,000	329,000	109,509,000
Georgia	3,243,000	1,080,000	157,759,000
Alabama	1,884,000	588,000	84,815,000
Rhode Island	979,000	87,000	41,932,000
Maine	705,000	120,000	20,153,000
New Hampshire	629,000	118,000	23,126,000
Connecticut	596,000	46,000	31,149,000

The New England area owes its continued importance to its early start. The region has the moist type of climate that was necessary for cotton manufacture before humidifiers were invented and has abundant water-power resources, good commercial location, and a plentiful supply of labor. At first the factories were small and scattered, but as the demand grew, they became larger and tended to concentrate at the larger power sites. Later,



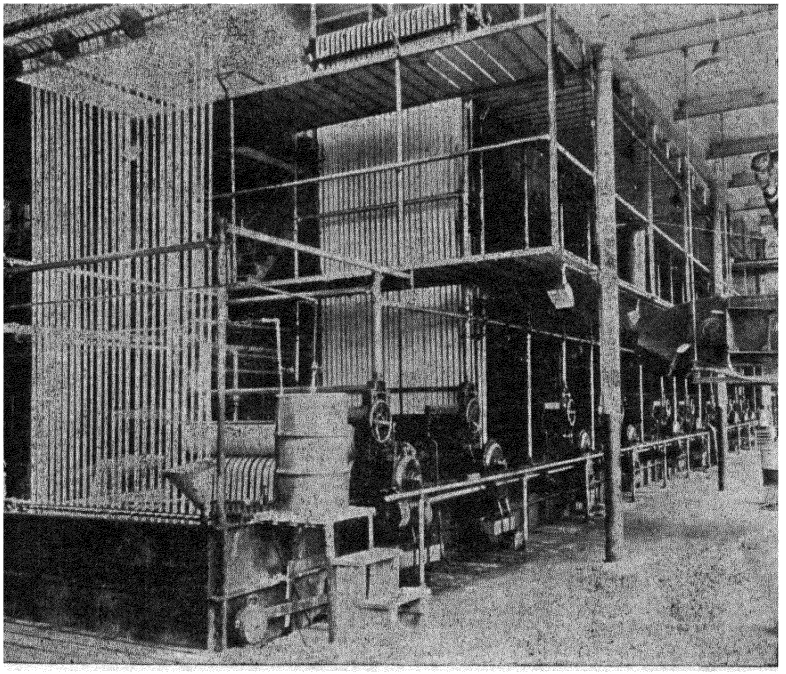
The Erwin Cotton Mills Co.

Fig. 116. Weaving room of a cotton mill.

when the water-power facilities were outgrown and coal had to be used, the factories were drawn to the cities along the coast, where coal could be obtained cheaply from the middle Atlantic ports. Lawrence, Lowell, Manchester, Fall River, and New Bedford are the more important centers.

Recently New England has been losing ground to the southern Appalachian region. It has tried to meet this problem by mergers, by concentrating more on the production of quality goods, and by paying more attention to style goods. Some mills have a staff under the supervision of a director to study styles. The closing of mills has resulted in unemployed labor and factories which can be bought for bankrupt prices.

The Mohawk Valley is the principal knitting district of the country. Cohoes is the leading center, but Amsterdam, Little Falls, and Utica are important. Troy makes nearly the entire supply of collars and cuffs for the nation. It is said that the industry became established there because the detachable collar and cuff were invented there. The valley owes its importance to



The Erwin Cotton Mills Co. Photo by the Paton Studio.

Fig. 117. Yarn being run through dyeing vats and carried up on skiers for oxidation.

water power, water transportation, the ease of obtaining coal by way of the valley of the Susquehanna and its tributaries, and skilled operatives.

The southern centers, on the whole, turn out cheaper types of products than the northern, chiefly because of the lack of skill and experience, a handicap that is gradually being overcome. The chief advantages of the South are cheap labor, less strict labor laws, low taxes, nearness to raw material, abundant water power,

and nearness to the coal of West Virginia and Alabama. With the growth of the industry, the advantages with respect to labor and taxes are almost certain to diminish, relatively. Weaving predominates in the South, but there is much knitting at Chattanooga and in North Carolina.

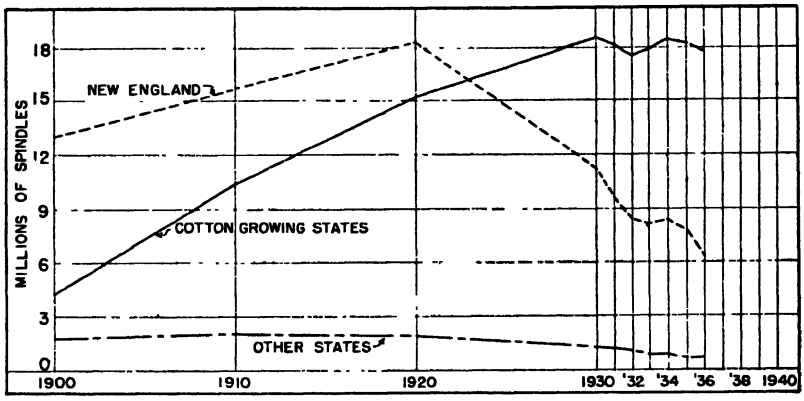


Fig. 118. Regional distribution of active cotton spindles in the United States.

WOOL

Manufacturing operations. When wool has just been sheared, it contains dirt and grease which must be removed. The dirt may be removed mechanically or with acids and heat. The grease is scoured out by chemical means, the wool losing about one third of its weight in the process. The grease is sold to the manufacturers of toilet soap. Scouring leaves the wool harsh and wiry, and before it is used it is sprayed with olive oil to make it pliable.

The two basic types of wool manufactures are worsteds and woolens. In the former the fibers are parallel and usually made from long wool. Woolens are made from shorter wool, and the fibers are mixed and crossed. The cloth is softer and more elastic than worsted. For both the wool is carded. For worsteds it is also combed. Combing not only removes the short fibers, but continues the straightening of the fibers, which was begun in

the carding process. The wool is then run through drawing machines until the required size of yarn is obtained, the wool for worsteds being twisted harder than that for woolens. The weaving processes for the two are alike, and the finishing of each is basically similar to that of cotton.

Centers of manufacture. There are small wool mills scattered over the country, but wool manufacturing tends to concentrate around fewer centers than does cotton. It is used in much less quantity and in a less wide variety of products than cotton. Because of the rise of the automobile and the movement of people to the cities, where they spend most of their time indoors, a decline in the demand for wool has resulted. Consequently, small factories, unable to meet the competition of large, efficient plants, have been closed.

Products of wool other than worsteds and woolens are rugs and carpets, shoddy, and felt, the latter chiefly for hats. Shoddy is an inferior cloth made from old woolen rags which have been torn into their original fiber, or it may be simply the fiber from old woolen rags. Its manufacture has been increasing in the United States, for nearly 20 per cent of the material in woolen cloth is shoddy. In making felt, the wool is carded and placed in layers, after which it is run between heavy rollers and beaten and pressed. Felt for hats is wool mixed with either rabbit, raccoon, or beaver hair.

The manufacture of these different products tends to specialize around certain centers. Philadelphia is the leading wool-manufacturing city in the country, and because of its cotton, silk, and rayon industries is, in fact, the leading city in the manufacture of textiles. It is important in all branches of the wool industry, producing about one third of the carpets and rugs of the country, 20 per cent of the hats, and 9 per cent of the worsteds and woolens. It is also an important knitting center. The industry was first established in the United States at Germantown by a colony of hand knitters from Hanover. The early start, the fact that much of the wool for certain products is imported, and the

favorable location for marketing are factors in the growth of the industry. But the largest worsted mill in the world is at Passaic, New Jersey. The chief hat-manufacturing center is Danbury, Connecticut. In New England, Lawrence, Providence, and Woonsocket owe their importance to the same general conditions that gave rise to the manufacture of cotton in those areas. Massachusetts manufactures 25 per cent of the national production of woolens and worsteds, and Rhode Island about 16 per cent.

SILK

Growth of silk manufacture. The United States produces but a negligible amount of raw silk, and this only for experimental purposes; it is, however, the world's leading manufacturer and consumer of silk goods. The rise and growth of the silk industry are accounted for by a protective tariff on manufactured silk, the high standard of living which prevails, machine methods, and concentration on the production of the medium-priced or more standardized types of product that are in general demand.

Manufacturing operations. Silk is imported in bales containing a large number of skeins. Too weak for most uses, the thread in the skeins must be put through a process of twisting and doubling to add the necessary strength for weaving. This process, called "throwing," corresponds to the spinning process in the manufacture of cotton. Throwing requires large capital investment, much time for its completion, and a great deal of care and supervision. For these reasons it is usually done in independent establishments. The amount of twisting and doubling depends on the product to be made. *Organzine,* the warp thread, receives 16 twists per inch, after which two or three threads are placed together and doubled and twisted 14 times in the reverse direction. *Tram,* the weft thread, consists of threads doubled and then given two or three turns per inch. Crepe gets its crinkly appearance because the threads are twisted from 40 to 80 times per inch. Before throwing, the skeins are soaked for about 12 hours to remove the gum; afterwards the yarn is given a soap-and-water

bath and run over rollers to equalize the diameter. It is then reeled into skeins of 500 to 2,500 yards, ready for weaving. The weaving, knitting, and finishing processes, except weighting, are essentially the same as for other textiles. Since the removal of the gum often causes the loss of one third of the weight, tin is added to counteract such loss. This is known as weighting. The process may also add certain desirable qualities, but the practice may be abused.

Centers of manufacture. The manufacture of silk first began at Passaic, where water power, foreign skilled workmen, and the New York market were near at hand. The latter was important because New York City is a style center. As the industry grew, it extended outward from this center, chiefly into Pennsylvania, which, in the river valleys in its eastern coal fields, chiefly around Philadelphia, Allentown, and Scranton, now manufactures 41 per cent of the silk of the nation. Paterson, in the original area, is still the leading silk-manufacturing city in the world. New York City and Connecticut are also important.

It is evident that the manufacture of silk is more localized than that of the other textiles, because of the importance of the New York City and the Philadelphia markets to the industry, and because the raw material is nearly all imported from a single source. Since the raw silk is also valuable, its movement is not hindered by high freight rates. These factors permit the location of the industry where the other necessary factors are most favorable. Expansion into Pennsylvania has occurred because of the large supply of woman and child labor from the families where the men work in the coal mines, steel mills, and other heavy industries. The same type of labor has been available in New Jersey. Because of the type of labor employed, some people have called the industry a parasitic one; others have considered it a more efficient way of using the available productive resources.

Silk manufacture is specialized geographically, and the specialization of plants is more marked than in the case of any other textile. The tendency has been for the preliminary and less

skilled operations to be done in the newer districts. Thus Pennsylvania leads in throwing; New Jersey is more important relatively in weaving.

A separate branch of the silk industry, the knitting of silk hosiery, is more scattered than the others. Philadelphia is the chief center, followed by Chattanooga. North Carolina, however, ranks next to Pennsylvania among the states. The industry has grown rapidly in the Midwest, with Indianapolis as an important center. Cheap labor and markets are important factors in all of these centers. Knitting mills can be operated on a small scale more profitably than can most other types of textile mills.

RAYON

Nature. Rayon now ranks third among the five great textile fibers, and is the only one which the ingenuity of man has produced. It has attained this importance since 1884, when it was patented by the French chemist de Chardonnet. It is a product of chemistry and mechanics, made from cellulose, the material of the cells that hold the living protoplasm in plants. The cellulose, first treated with various chemicals in special types of mechanical equipment, is made into a thread when it is forced through very fine openings, or spinnerets. Several threads are spun into a yarn.

Uses. Compared with the present product, the first rayon was a poor article and was used only in braids, trimmings, and novelties. But there has been a gradual improvement in the quality of the fiber until today it is used in a multitude of products. It is important in underwear and hosiery, these and similar uses consuming about one half of the present production. It is also used for delicate fabrics for dresses and gowns, ribbons, ties, draperies, washable wallpaper, and insulating material in the electrical industry. It may be used alone or combined with the other textile fibers to give various effects. Much cheaper than silk, it has been substituted for it in many uses. It has somewhat the appearance of silk, and for a few purposes some types are even better

than silk, but it is more closely related in nature to mercerized cotton than to silk. About a quarter of the production is now mixed with cotton in manufacture.

An important quality of rayon is its ability to take dyes well. When it is mixed with other fibers, many beautiful cross-dyed effects are obtained. This is because it will take the same color in the same bath with a different shade than the other fibers, and because one type of rayon has no affinity at all for the colors which some of the other fibers or even other types of rayon will take.

In spite of great improvements rayon still has the disadvantage that it loses its tensile strength when wet and must thus be handled carefully when being laundered. It regains its original strength when dry, however.

Processes and raw materials. There are four methods for making rayon, their differences being chiefly in the nature of the chemical treatment of the raw material. Almost 85 per cent is made by the most recent, or the viscose, process. It uses wood pulp chiefly for its raw material, the spruce of this country and Canada being the best wood. The other three methods usually employ cotton as their basic material, using linters and waste cotton. The viscose method is important both because wood pulp is cheaper than cotton, and because it is chemically a less difficult process than the others. The other processes are the nitro, cuprammonium, and acetate. The acetate process makes the strongest fiber, but the difficulties of making it and of working it up have until recently limited its use. Now it is increasing in favor, and some manufacturers think that ultimately it may displace the viscose process. The acetate process makes a beautiful product of lower inflammability and absorbent power than the other processes.

Location of the industry. There are two divisions of the rayon industry: the manufacture of the yarn, and the conversion of the yarn into various products. Both processes, unlike those in the manufacture of other textile fibers, are not carried out in the same

factory. The knitting and weaving of rayon yarns into different products takes place in the main textile-manufacturing centers of the country.

In the making of the yarn itself, Virginia, Pennsylvania, Tennessee, and West Virginia rank in the order given and together produce about three fourths of the nation's total. Important centers are around Richmond, Covington, and Roanoke in Virginia, Elizabethton in Tennessee, Parkersburg in West Virginia, and Marcus Hook in Pennsylvania, where the first rayon factory in the United States was built. New Jersey and Delaware also have factories near Marcus Hook. It will be observed that many of the centers are where other types of manufacturing have not been important. Cheap labor can easily be obtained, because the mills need not compete with other industries for workers, and because these areas contain large numbers of rural people who can easily be attracted to the factories. These rayon centers are located favorably for sending out their yarn to the various textile-manufacturing districts and are in a region with abundant supplies of soft water, which is very necessary.

Pennsylvania manufactures 25 per cent of the rayon yarn into finished goods, and North Carolina 15 per cent. Massachusetts is almost as important as North Carolina and is followed by Rhode Island.

MANUFACTURE OF WEARING APPAREL

Nature of the industry. The manufacture of wearing apparel is a secondary textile industry. The small amount of capital required to enter the industry and the risk due to style changes keep it small scale. This industry started because of the invention of the sewing machine, and because of the demand for clothing for the army during the Civil War. The work may be done in sweatshops, where long rows of machines may be placed in lofts and other low-rent locations, or in the homes of the workers, the employer buying the material and cutting it up.

Location. The manufacture of apparel locates in the large cities, where cheap labor and huge markets are at hand. New York is by far the leading center, manufacturing half or more of all of the apparel made in the country. That city specializes in the cheaper kinds of products. Immigrants formerly provided cheap labor. The large population of the metropolitan district and the nearness of New York City to other centers of population provide a large market. Apparel is also able to bear relatively high freight rates. Chicago and Rochester are next in importance, both making the better grades of clothing. Philadelphia, Baltimore, and Boston are other centers.

Small establishments for making cheap dresses, shirts, and overalls are found widely scattered, often being located in small country towns. Local demand, surplus labor, and the small capital requirement make possible the establishment of such plants.

IMPORTANCE OF THE TEXTILE INDUSTRY

The manufacture of textiles, including wearing apparel, is our leading manufacturing industry in several respects. The industry normally employs in excess of 1½ million workers, double the number employed in the manufacture of food products, the next ranking industry in the employment of workers. About two thirds of the total number are employed in making textiles, and one third in making wearing apparel. In the number of factories and the value added by manufacture, textile manufacturing is outranked only by the manufacture of food products, and is considerably higher in the latter respect than any remaining industry except the manufacture of machinery (see Figure 8). The textile industry is also ahead of any other industry by 50 per cent in the amount of wages paid, machinery being next; and it is outranked only by that industry and by printing and publishing with respect to the amount of salaries paid. The value added by manufacture thus consists largely of labor costs.

Foreign commerce in textile products. Previous to 1930 the United States had an important export trade in textiles, largely cottons. Because of the world-wide economic depression, which set in at that time, and also because of the rise of Japanese competition in the manufacture of cheap cotton products, the branch of the industry in which we hold an advantage, this trade has now declined to one third of its former quantity. Now imports, which formerly were only half as valuable as exports, outrank the exports in value. The imports have declined in value, but the quantity is as great as ever, the result of imports of cheap Japanese products. Excepting those from Japan, the imports are principally products of high quality from Great Britain, Germany, and France. There are also large imports from Puerto Rico, that island being at the same time a leading export market: fabrics are imported into Puerto Rico from the United States, made into various types of wearing apparel with cheap labor, and then exported back to this country. Other important markets are in the Caribbean region, British South Africa, Hawaii, and the Philippines. Some silk and rayon manufactures and small amounts of wool products are exported. Cottons are the leading import, but the imports of woolens, largely from Great Britain, are about half as valuable.

Textile manufacturing, supplying one of the basic necessities of life, characterized by plants of moderate or small size and by processes that require on the whole but little skill in the workers, and using a variety of raw materials, widely grown, has tended to spread gradually over the world. Because the newer manufacturing districts, with less skill and experience, make the cheaper types of products and because of their low wage rates, they create keen competition for the older centers, the latter usually finding it necessary to readjust operations to the production of goods of higher quality. The small capital required and the relative simplicity of the operations make overexpansion easy.

19

FOOD MANUFACTURES

THERE are more than a dozen separate food-manufacturing industries in the United States. As a whole these included 29 per cent of all the manufacturing establishments of the nation in 1935, 11 per cent of all the wage earners employed in manufacturing, and 28 per cent of the value of all manufactured products. Five of these industries, however, produced 62 per cent of the total value of food manufactures during that year. These were meat packing, 25 per cent; baking, 13 per cent; flour milling, 9 per cent; dairy products, 8 per cent; and the canning and drying of fruits and vegetables, 7 per cent. Although the many sources of raw materials and the widespread demand cause food-manufacturing plants to be scattered widely, 43 per cent of the total output was credited to the five states of Illinois, New York, California, Pennsylvania, and Minnesota. The first two were about equal in importance, and together produced 24 per cent of the national output. Ohio and Wisconsin were almost as important as Minnesota, followed by Iowa and Missouri. This distribution of states indicates the importance of raw materials, markets, and transportation in locating the factories. New York is important because of the great population to be fed, abundant supplies of local raw materials, location on a great thoroughfare for exporting and importing, cheap water transportation, and cheap labor. Only the more important food-manufacturing industries are discussed in this chapter.

MEAT PACKING

History. The meat-packing industry gets its name from the practice of early settlers of curing, smoking, and packing pork

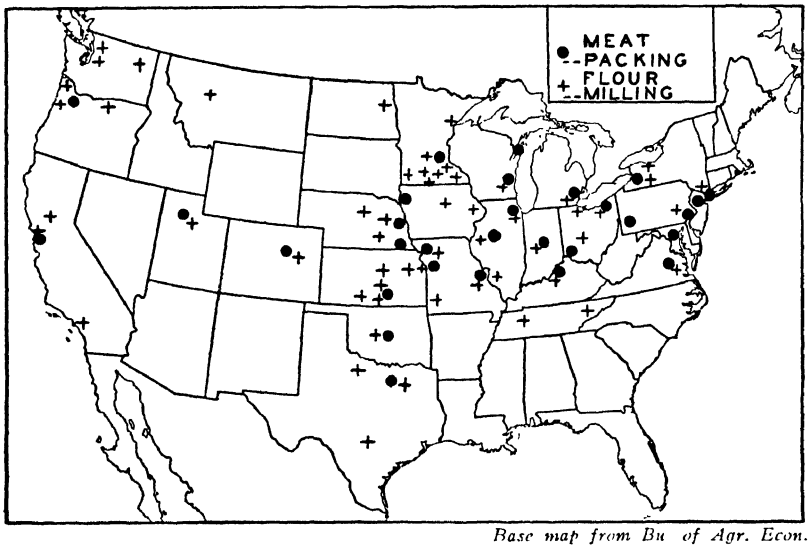
for home use, a practice later commercialized. Cincinnati and Buffalo became important early centers. Since other meats could not be preserved well by this method, an important business in sending live animals to the eastern markets developed. This changed, however, with the discovery of refrigeration and of methods for sealing cans of meat. The cost of shipping live animals for long distances is high. There is a large loss because of injury and shrinkage, and only a little over half the weight of the animal is meat. Therefore anything that would permit the preparation of meats near the region where the animals are grown would usually be an advantage.

Organization of meat packing. There are meat-packing companies that operate on a national scale and those that sell only locally, the former doing about two thirds of the total business. The growth of chain food stores with meat departments has increased the business of the smaller packers, who were willing to give price concessions denied by the larger packers. The large concerns have the majority of their factories in the centers where the livestock are fattened, but they also have some near the consuming markets, and even in foreign countries. Generally they control their own systems for marketing; and, in some cases, they own the cars, which are only leased to the railroads, to move the meat to market. Large companies operating nationally are necessary because of the long distances between the meat-producing and the meat-consuming regions. Each section of the country demands particular types of meat. For example, the South likes its beef lean and its pork fat, while in the upper Mississippi Valley the reverse is true. A large company obviously can organize the slaughtering and marketing to much better advantage than a small one.

Another reason for the dominance of the large companies lies in the utilization of the by-products. A small company has too little volume to install profitably the necessary equipment and processes, which are expensive. The large companies assert that

their profits are derived largely from the sale of the by-products, the meats selling at cost.

The nature of their business also makes it easy and economical for the large packers to expand their activities to include allied lines, such as dairy and poultry products. Were it not for our fear of monopoly, they would probably expand more widely than now, but we limit them by law.



Base map from Bu of Agr. Econ.

Fig. 119. Principal meat-packing and flour-milling centers of the United States.

By-products. About 54 per cent of the weight of a live beef animal becomes meat, 20 per cent is lost through shrinkage, 10 per cent is valueless, and 16 per cent is made into by-products. There is a multitude of by-products, but only the more important classes will be mentioned here. The most valuable are the hides, which are sold to tanners for leather. Next are the different qualities of fats which are used to make margarine, cooking compounds, and soap. The bones and some of the scraps and blood are manufactured into fertilizer, while scraps of meat and blood are made into feed for animals and poultry. The bones are also used to make glue, gelatin, and knife handles and similar prod-

ucts. The glands and some of the blood are made into drugs and medicines. The hair is sold to the manufacturers of mattresses, brushes, and other products. Some of these by-products are made into finished products, and others become intermediate products to be sold to the manufacturers of other commodities.

Organization of a meat-packing plant. A large meat-packing plant has three departments: power, slaughtering, and refrigeration. The processes are highly organized or coördinated and are accompanied by a minute division of labor, made possible by large-scale operations. Meat packing is a dissembling type of manufacture; and because the raw material is alive and not standardized, it cannot be worked up with machinery to the extent that most other products can. A description of the methods used for swine will show the features of the work.

First, a chain attached to a revolving wheel is fastened to a hind leg of the animal, the wheel then lifting the animal to a sloping rail, at which its throat is cut. In a few minutes the dead animals are carried through vats of scalding water on conveyors, where rapidly revolving, dull steel knives scrape off the bristles. The animals are then dropped onto a moving table, where the head and feet are scraped. Then they are suspended by the hind legs from a moving conveyor which carries them past the workmen, each of whom has a special task to do in cutting up the animal. The various parts of the animal are then taken in a similar manner to the proper divisions of the plant for further processing or storage.

Location of meat-packing plants. The distribution of meat-packing plants is shown in Figure 119. They are largely in the regions where the animals are fattened. Particular adjustments of freight rates, local supplies of raw materials, and special market demands, however, cause considerable slaughtering near the markets. There are meat- and poultry-packing plants in New York City, for example, because religious requirements necessitate fresh meats for the large Jewish population. Systems of farming result in animal fattening in the East, and the surplus dairy cattle pro-

vide an added source of animals. As previously stated, efficient transportation and refrigeration caused meat packing to concentrate in the grain regions because of the economy in transporting meats instead of animals. But in competing for business, railways may charge rates that will favor the movement of animals relative to that of meats. Animals may also move to distant packing centers under special (commodity) rates. After the World War, the several flat or horizontal freight rate increases tended to favor the moving of animals over longer distances, because the actual rate on meat is higher than on animals, owing to the higher relative value of the meat. A flat increase, for example 20 per cent, amounts to a larger absolute sum on the higher figure. The increasing importance of eastern centers during the past decade is accounted for largely by this condition.

Chicago, with about 15 per cent of the national output of meats, is the leading meat-packing center, and is followed by Omaha, St. Paul, and Kansas City. The greatest area of concentration is in the larger cities along the Missouri River.

THE MANUFACTURE OF CEREALS

Divisions of cereal manufacture. The industries which will be discussed here are flour milling, baking, and the preparation of breakfast foods.

Flour milling. Modern flour milling dates from the seventies, when the gradual-reduction process for milling wheat was discovered. Before that time hard wheats could not be milled successfully because the grains were so brittle that the brown part could not be separated from the white. Three parts of a grain of wheat are important in milling: the brown outer covering, the germ, and the white starchy interior. Milling must eliminate the first two if white flour is desired. In the gradual-reduction process, the grains of wheat are crushed between rollers which are at first far apart. Successive sets of rollers get closer and closer together and gradually separate the white material from the hull. During the process the pulverized material is sifted several times to re-

move any undesirable matter. Wheat returns about 72 per cent in flour. The bran and shorts remaining are used for stock feed.

Organization of flour milling. The bulk of the flour and most of the patent brands are made by a few large mills. There are, however, hundreds of small grist mills over the country which do a custom grinding business, and some of them market products of their own.

The milling of flour is a continuous process once it is started, done almost altogether with automatic machinery; there are relatively few workers in a flour mill.

Location of flour mills. Flour mills are located at centers in the grain-growing regions, near consuming centers where there is cheap transportation for obtaining grain, and at intermediate points where both raw material and local markets are available. New York, Minnesota, and Kansas are each of about equal importance in flour milling and, together, mill more than one third of the nation's flour. Buffalo, the leading center in the East, is at the end of cheap lake transportation and near the important industrial centers. Buffalo also mills a great deal of Canadian wheat in bond for export. Minneapolis, the leading western center, is in the heart of the spring-wheat district and obtains power from the falls in the Mississippi. Kansas City, at the junction of river routes, is a center for the marketing of winter wheat, and is located favorably for marketing flour over a wide area. Freight rates are so important in locating flour milling that a separate section is given to the discussion of their influence.

Flour milling and freight rates. Flour milling provides an excellent example of the manner in which freight rates and rate policies can affect the location of industry. On the whole, both wheat and flour have been transported from the grain regions to the East at the same rates, in spite of the fact that it is said to cost about 25 per cent more for the railway to haul flour. This condition has existed because millers in the East said they could not compete otherwise with those of the West, who in turn claimed

that they could not sell flour in the East in competition with eastern millers unless they had a rate on flour the same as that for wheat. In addition, the railways, in competing with each other for traffic, have given manufacturing-in-transit privileges to millers located at intermediate points. Thus, wheat may move under a special through rate from Minneapolis to Philadelphia, for example, and a miller at Indianapolis may unload it, mill it, and ship the flour to Philadelphia under the original through rate. Milling points throughout the East are thus equalized, and flour milling is widespread as a result. Breakfast cereals are also manufactured under such privileges and move on to markets under rates applying to wheat.

The milling of other cereals. Small quantities of the other cereals are either ground into meal or milled into flour. The amount of corn ground into meal is about 10 per cent as great as that of wheat used for flour. Missouri and Texas are of equal importance and, together, grind about 20 per cent of the total output. They are followed by New York and Tennessee. The Southern States are important consumers because of the relatively large amount of corn meal used in the diet there. About 10 million bushels of oats are ground each year, Texas leading with 25 per cent of the total. About 15 per cent of the rye crop is made into flour, Minnesota milling 50 per cent of this amount and Wisconsin 15 per cent. Only 2 per cent of the barley is made into flour, California leading with 60 per cent of the total, followed by Washington.

Bakery products. Over half the flour produced in the United States is consumed in commercial bakeries in making bread, cakes, soda crackers, cookies, macaroni, and similar products. Home baking is still important, but the rise of the motor truck and paved roads and improvements in the machinery and methods for wrapping bread, and the large-scale bakeries which have resulted from these changes have so lowered the costs of bakery products that they can often be purchased for less than the cost of

making them in the home. These bakeries are more economical in the use of flour than the older ones; they use more of other ingredients and have developed better methods for blending flour. Bakeries which make the more perishable kinds of products, such as bread or cake, are located mainly in the large and moderate sized cities. But almost any town of a few thousand people has a small bakery which supplies the demand of the town and the surrounding region.

The more durable products, such as crackers, are made in a relatively small number of plants located in the larger cities. Each city supplies a given marketing area. The factories are large, and the processes are simple and are performed largely by machinery, and with a high degree of division of labor. One company, with many plants, manufactures half of the crackers made in the country.

Breakfast foods. The annual value of breakfast foods is a little greater than that of our beet sugar output. Oats contribute half the quantity in weight of cereals used for the purpose, and wheat one third; but the value of breakfast foods made of oats is only 60 per cent of that of cereals made of wheat. About one third as much corn as oats is used for these products, but those made of corn are 75 per cent as valuable as those made of oats As was stated in Chapter 8, usually only a little more than 1 per cent of our annual production of oats is made into breakfast foods.

The manufacturers of breakfast foods locate their plants according to the same principles as those which apply to the location of large-scale flour milling. Southern Michigan, near both raw materials and markets, is the leading district. Battle Creek, the principal city, seems to owe its start to the presence of a sanitarium whose owner used the products which he developed to feed his patients. Iowa ranks second, with Cedar Rapids as the most important center in the country for breakfast foods made of oats. New York, Ohio, and Illinois follow Iowa. On the west coast, Oakland is the leading manufacturer. There are also many small mills over the country which manufacture and market their own

brands, which usually do not require complex processes of manufacture.

THE CANNING INDUSTRY

History. For the most part the food-canning industry dates back to the middle of last century. It depended in its origin upon the methods of preservation which resulted from the research of two Frenchmen, Nicolas Appert, the "Father of Canning," who developed the principle of sterilization by heat, and Louis Pasteur, whose work is familiar to all. Though their efforts laid the foundation, it was only a beginning. Other scientists have improved the methods of preservation, and have adapted them to many products. Only recently has it been possible to market canned orange or grapefruit juice in competition with the fresh fruit. The research of others has given the world the principle of refrigeration, which has been improved constantly. The recently discovered quick-freezing process has made it possible to have products with qualities that would be unattainable otherwise in many places or at certain seasons.

Economic importance of food preservation. The development of methods for preserving foods has freed people from their dependence on local supplies and has given them a year-round supply of a greater variety. All places are thus enabled more and more to develop in accordance with the principle of comparative advantage, which is, in substance, that every locality should specialize in the production of those products which, with a given expenditure of labor and capital, will return the greatest net profit. This assumes, of course, that there are transportation facilities, which, in themselves, are highly important in the operation of this principle. Preservation also makes a better diet possible and stabilizes prices for both the producer and the consumer.

Organization. Meats, fish, fruits, and vegetables are all sold in canned form, but this discussion will be limited to the latter two, which are much more important than the others.

Canneries are usually small concerns located wherever the

supply of raw material is sufficient to keep them operating through the season. Recently, however, probably because of the expansion of vegetable growing and truck transportation, there has been a tendency toward larger plants, which are not affected so adversely by occasional bad years as are the smaller ones. The Heinz plant in Pittsburgh is the largest of its type in the world.

It is important that the industry be carefully organized and coördinated. In order to assure themselves of a sufficient supply of the proper grade of raw materials, canners often make contracts with the growers, or sometimes grow their own products. The larger canneries hire experts to advise the private growers, and they furnish the farmer with plants for transplanting. In this manner improved types of plants have been developed, which have been of benefit to grower, canner, and consumer. It is also necessary that the crops be harvested at the proper time and that they be received in good condition and be carefully inspected to remove defective products.

Canning is done largely with ingenious machines that have been invented to do special types of necessary work. For all products the cans are filled and sealed mechanically. There are machines that husk ears of corn and others that remove the silk and cut the corn from the cob. Tomatoes are washed, scalded, and peeled by mechanical means. Formerly, thousands of workers were required to shell peas, and there was often a shortage of labor. But now peas are canned almost entirely with machinery, the vines being cut in the field and hauled to the cannery, where the peas are shelled without removing the pods from the vine.

Canning centers. There are four important canning centers: the Baltimore district, the lake plain of New York, southern Wisconsin, and California.

Baltimore is the greatest canning center in the world. The geographic conditions of the region around Chesapeake Bay make possible the growing of a variety of fruits and vegetables, and the upper part of the Bay is the center of oyster fishing. Since the

oysters can be marketed during the winter months, year-round employment is given to the canneries and to the workers. Water transportation makes it cheap to assemble the vegetables, and large markets are within easy reach. The chief vegetables canned are tomatoes, beans, and sweet corn.

In western New York, peas, cabbage, snap beans, tomatoes, and sweet corn are the leading vegetables canned; cherries and grape juice are important among the fruits.

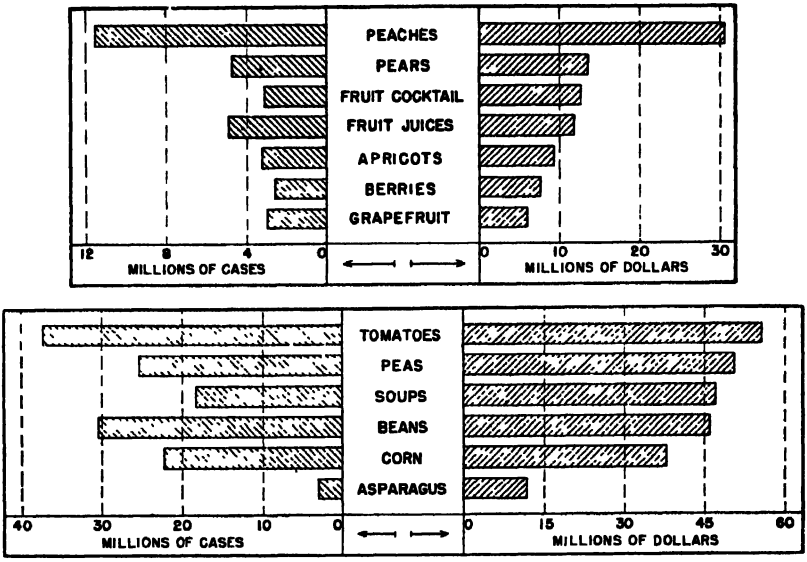


Fig. 120. Principal fruits and vegetables canned in the United States in 1935.

Wisconsin is important for peas, cabbage, sweet corn, cucumbers, and snap beans, about half the national supply of peas being canned there. Wisconsin and New York together can 60 per cent of all the cabbage and 25 per cent of the snap beans.

California for the most part cans fruit, but also a considerable amount of vegetables, supplying practically the entire output of canned spinach and asparagus. Canning is important to California because of the long distance to market. Winter vegetables are shipped out fresh, but the cost is high.

DRIED FOODS

The drying of fruits and vegetables. Both fruits and vegetables are dried in the sun and by mechanical means, but the latter method is unimportant. The quantity of vegetables dried for commercial uses is negligible. For reasons that have been discussed already, California is the only state which is important in the drying of fruits. The annual national output of dried fruits is a little more than one billion pounds, valued, at prevailing prices, at $57,000,000. Prunes and raisins each contribute one third of the total quantity and an equal proportion of the total value and are followed by apples, peaches, apricots, and figs.

SUGAR REFINING

Nature of processes. The essential nature of sugar refining is to crystallize the granules out of a liquid solution. The processes for sugar cane and sugar beets differ in the early stages.

Cane sugar comes to the refinery in the form of raw sugar, in appearance somewhat like grains of wheat. This product is the result of boiling the juice after it was crushed from the cane. The cane is boiled near the growing regions because of the large amount of juice which must be evaporated. At the refinery the crystals of raw sugar are melted, and the resulting solution is purified by being run through bone black. The filtered liquid is then boiled in vacuum pans until crystals begin to form. After separation from the syrup, the crystals are washed and dried, and separated as to size. One hundred pounds of raw sugar make ninety-three pounds of refined sugar. The refining is a continuous process, and great dependence on mechanical means is obviously necessary.

In the making of beet sugar, the beets are sliced and their sugar is extracted with hot water. The solution is then purified several times, after which crystallization takes place as with cane sugar. Filtering with bone black is not necessary with beet sugar because white crystals will result without it. Cane and beet sugar are similar except for the greater amount of mineral matter in the

latter. The molasses from beet sugar is not edible because of the combined mineral matter, but it is mixed with the pulp for stock feed. Refining is done cheaply because the refineries are large and well organized.

Location of refineries. Cane sugar is refined in many of our larger seaports; the beet sugar factories are in the beet growing areas. There are 13 cane sugar refineries on the Atlantic, 6 on the Gulf, and 2 on the Pacific coast. The leading cities are New York, where most of the cane sugar is refined, Philadelphia, Boston, Baltimore, Savannah, New Orleans, and Crockett and San Francisco in California. Several of the plants belong to a single company, which refines about 25 per cent of our supply and is the leading refiner in the world. Seaports are important centers for refining because much of the raw cane sugar is imported, and because it is more economical to ship the refined instead of the less valuable raw sugar when shipping by railway.

There are about 80 beet sugar factories, one company owning 25 per cent of them. Depending on overland transportation for obtaining the beets, the factories try to locate centrally, and are necessarily much smaller than the average cane-sugar refinery. The tendency recently has been toward fewer and larger factories.

By-products. Several by-products are obtained in the refining of both cane and beet sugar. Molasses, rum, and celotex are products resulting from the manufacture of cane sugar. The molasses is a good fattener and is used in feed mixtures for livestock. It is also a source of industrial alcohol. Celotex is a construction material made from the bagasse, or crushed stalks from which the juice has been removed. It is a nonconductor of heat and sound and is used in lining refrigerator cars, and in lining the walls of hospitals, radio studios, and other buildings to deaden sound. The bagasse, with an addition of fuel oil, is also used as fuel in the *centrals,* and in the manufacture of paper. The ash resulting from its use as a fuel contains phosphorus and potash. The cane tops are sometimes used for ensilage where other crops cannot be grown easily.

By-products of beet sugar production are chiefly the tops and crown and the pulp. All are used for stock feed. There are about 3 tons of tops and 1 ton of crowns per acre. When dried, the leaves are equal to first-class hay in feeding value. They may also be fed green or put in a silo, or they may be plowed under for fertilizer. Ground beet seed also is used for stock feed.

Fresh pulp comprises about 80 per cent of the weight of the beets. Since the pulp is good for fattening animals, most sugar beet regions have an animal fattening industry. Used either wet or dry, it is often mixed with other feeds. Dry pulp may be shipped easily and is a popular feed.

Other products obtained from beets are molasses and lime cake. The former gives stock feed, alcohol, vinegar, fuel oil, and fertilizer; the latter, material for fertilizer, cement, and wall boards. The lime is added in the refining process and is then reclaimed.

DAIRY PRODUCTS

Products made. About 46 per cent of the production of fresh milk is manufactured into various dairy products. About 78 per cent of this amount goes into butter, and between 7 and 8 per cent each into cheese, ice cream, and evaporated and condensed milk. The other important products—dried skim milk, dried, evaporated, and condensed buttermilk, and casein—are for the most part by-products, utilizing the waste or the residue from the manufacture of the others.

Location of manufacture. Dairy products, because of the perishability and bulk of fresh milk, are processed largely in small factories scattered widely over the country. It requires 21 pounds of milk to make one pound of butter. Because of geographic or economic conditions, however, there is greater concentration in some areas than others. Many factories are owned coöperatively by the farmers. Often the milk or cream must be concentrated from over a wide area, and therefore truck routes, local cream buying stations, and good rail transportation are important elements of the industry.

The general demand and ease of manufacturing and storing cause butter to be more generally manufactured than the other products. It is made in the regions that are naturally adapted to dairying, in the grain regions where feed is cheap, and in the fresh milk areas as a means of utilizing surplus milk. About one third of the total production of butter is made on the farms, and two thirds of the farm production is consumed there. There are two kinds of creameries which make butter. One is the small local creamery found in regions which specialize in dairying. The other is the large establishment which exists in regions where dairying is a sideline, and must therefore concentrate milk or cream from over a large territory. Its large size gives it production and marketing advantages not possessed by the smaller type. Minnesota, with one sixth of the national output, is the leading butter state. Iowa and Wisconsin follow, and the three combined contribute 40 per cent of the total production.

A cool climate and an abundance of cold water are necessary for cheese manufacture, and these requirements restrict it to a few places. Cheese can be stored for a longer period than butter, and it utilizes a greater proportion of the milk than butter does. It is made by coagulating milk by adding rennet. The resulting curd is put in a form and placed under pressure for a few days. It is then rubbed with butter and placed on a shelf to cure, during which process a bacterial fermentation occurs. It must be turned every few days and have more butter added. It is ripened to suit the taste of the consumer—a process requiring from a few weeks to two years. Wisconsin produces about two thirds of the nation's cheese. The leading type is American cheese, a modified type of cheddar, but there is some Swiss and Limburger made in the southwestern part of the state. New York is second, with 10 per cent of the production. American cheese leads there, but Neufchatel and cream cheese are also made. Oregon and Indiana are next. The west coast produces Italian types.

Evaporated and condensed milk have about the same food value as fresh milk. The production is as widely scattered as that

of butter, but tends to concentrate more in the states naturally adapted to dairying and in the eastern part of the corn belt. Wisconsin contributes one third of the supply, followed by New York with 12 per cent and California with 9 per cent. The importance on the west coast is due to the long distance to important markets.

Casein, made chiefly from skim milk, is an important by-product. It is used as an adhesive, as a nonconductor of electricity, and as a non-explosive substitute for celluloid.

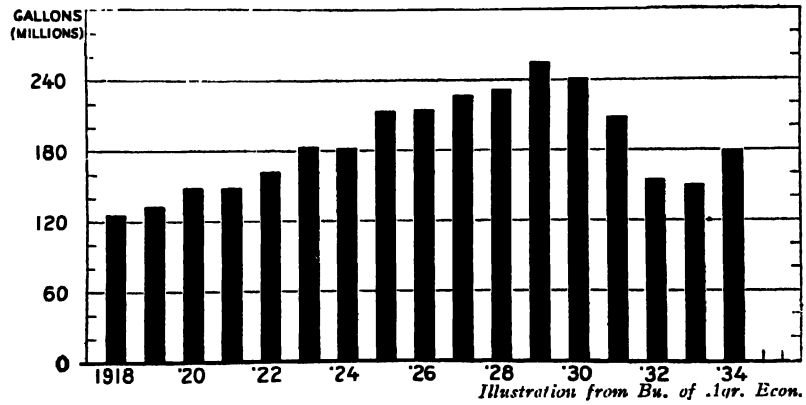


Fig. 121. Ice cream: United States factory production.

Dried skim milk is another by-product of increasing importance. At present it is used chiefly in bread, ice cream, and stock feeds. It is economical to ship and store, and convenient to use.

The manufacture of ice cream is an important industry in itself, and has grown rapidly in the past 15 years. Ice cream, because of its perishability, must be made locally. The truck and paved roads have had the same effect on this industry as on the baking industry. There are large companies in the business, but they have plants located at different places.

FOREIGN COMMERCE IN FOOD PRODUCTS

Our foreign commerce in food products is important, their export being 10 per cent of the nation's total exports; but the im-

ports of food products are three times as valuable as the exports. The latter, however, are 70 per cent of manufactured commodities, while the imports are almost entirely of raw products. In 1937 fruits—fresh, canned, dried—comprised 25 per cent of the total exports of food products, wheat 23 per cent, and packinghouse products 15 per cent; followed by fish and vegetable products. Cane sugar and coffee each were about 18 per cent of the total imports, followed by vegetable oils, liquors, fruits and nuts, and grains. The United Kingdom was our best market, buying more than 40 per cent of the exports and being particularly important for lard, pork, and fruits. Following the United Kingdom, but far less important, were Canada, Cuba, and France. Cuba supplied 15 per cent of the imports, but Brazil and Canada were only a little less important, followed by the Philippines and Colombia.

20

CHEMICAL INDUSTRIES

Chemistry in industry. Chemistry treats of the composition of matter, in which atoms and molecules are arranged in various combinations, and of the changes in molecular structure caused by the application of such forces as heat, light, or pressure. By the use of such forces the chemist has been able to break down the combinations and to arrange the atoms and molecules in new combinations which result in useful new products and the more efficient use of some existing products. The cracking process for petroleum, which was described in Chapter 6, is an example of the latter. The industrial applications of chemistry on a large scale are already highly important, yet they are so recent that their ultimate potentialities are by no means realized. For this reason some people think that the world may be on the verge of a period of chemical discovery and application which may be even more revolutionary in its industrial effects than was the Industrial Revolution of the nineteenth century.

The services of chemistry. Modern chemistry provides us with many products that otherwise would be available only at high cost. By chemical research the quality of products may be carefully controlled, making it possible to change many existing commodities and to create new or synthetic ones cheaper and better than those which they supplant.

By speeding up many processes, chemistry saves labor and other expense. It also conserves raw materials, utilizing them more completely, substituting the cheaper for the more expensive ones, increasing the durability of manufactured products, and utilizing waste.

Chemical industries. The chemical industries are those which deal with the preparation of products from raw materials through the agency of chemical change. It is sometimes difficult to distinguish between chemical manufactures and other types, because at some point or other most industries have processes which involve the principles of chemistry; moreover, some processes that are often classed as chemical may be only the assembling or the dissembling processes. In cases, however, where the processes are predominantly of a chemical nature, the term *chemical industries* is rightly applied. The Bureau of the Census lists about 35 such industries for the United States, the more important ones being the manufacture of heavy chemicals, paints and varnishes, fertilizers, soap, rayon and allied products, cosmetics, lubricating oils and greases, and explosives.

The chemical industry has an annual production valued at almost 3 billion dollars and employs nearly a third of a million workers. A marked characteristic of the chemical industries is the high value of the products compared with the value of the raw materials used. Values added by manufacture are remarkably great.

Requirements for successful chemical industries. The development of successful chemical manufactures requires skilled, patient, ingenious workers, and operators with ample capital resources, who have the foresight to let these workers go ahead unrestricted in their laboratories. In the larger industries numerous trained workers are necessary, and they can be employed only where there are large quantities of cheap raw materials. For this reason, water, air, and the more plentiful minerals are very important raw materials.

The investment in plant is so large, twice as much as a year's gross sales in the manufacture of alkali, for example, that a market must be practically assured before it is safe to engage in manufacturing.

Chemical raw materials. The minerals of major importance in the manufacture of chemicals are sulphur, pyrites, salt, coal, phos-

phate rock, and limestone. Important, also, are forest products. These basic raw materials are manufactured into what are called heavy chemicals or secondary raw materials, and are used either as agents in the further manufacture of chemicals or in various finished chemical articles. About 70 per cent of the output of chemicals is used as agents. Most chemicals then are intermediate, rather than final, products.

The chemicals into which the basic raw materials mentioned above enter are sulphur and pyrites into sulphuric acid; salt into caustic soda, chlorine, and fertilizer; coal into ammonia and coal tar; phosphate rock into fertilizer; limestone into lime and cement; and forest products into cellulose. All vegetable matter, of course, contains cellulose, but in the forests it is abundant, cheap, and waiting in reserve to be used. Some of the uses of these secondary products are described later in the chapter.

Development in the United States. The manufacture of chemicals on a small scale is as old as the nation itself, the colonists having paid their taxes to the mother country in potash. Certain types of chemicals had to be made locally because there were no resistant containers in which they could be shipped for long distances. The manufacture of explosives was begun about 1802, when Thomas Jefferson encouraged a member of the Du Pont family in France to come here for the purpose. Although our chemical manufactures were a major industry before 1914, the stoppage of German supplies during the War, and our need for them in our conduct of the War, changed this country within a relatively short period from an importer of chemicals to an important exporter. Now, the nation produces nearly half of the annual world value of chemicals.

Even before the World War the United States was a leading producer of chemicals but was, and still is normally, outranked by Germany as an exporter. At the time of the War, however, our products were of relatively simple nature and of a type that did not require great skill or complex processes. There was a limited market for the more complex type and keen competition from

abroad in providing the supplies needed; hence purchases could be made at low prices. As was stated previously, however, the World War forced us into the industry and showed us, along with the remainder of the world, the necessity for the domestic manufacture of such products. Since chemicals are vitally important in modern warfare, their manufacture is treated with that of the key industries.

Advantages which the United States does have in the manufacture of chemicals are abundant capital resources, able business leaders, and efficient methods of business organization, all of which are essential in the commercial application of chemical discovery.

The United States lagged behind some of the other nations in chemical progress because our natural resources long were so plentiful that it did not pay to conserve them. In Europe, with its dense populations and relatively scarce natural resources, materials had to be used much more efficiently. Since we had plentiful materials, our industrialists had not until recently seen the necessity for hiring industrial scientists and providing them with the facilities for research. Now, depleted supplies of natural resources in some lines and the rise of great competitive corporations which are desirous of continued existence and stability of operations are bringing about the expenditure of enormous sums of money, by both public and private agencies, for the purposes of scientific research.

American contributions in industrial chemistry. Among the important chemical products or industries which have resulted largely from chemical research in the United States are electrochemical and electrometallurgical manufactures, cellulose, plastics, high quality glass in large quantities, synthetic ammonia, the refining of petroleum, and the use of natural gas as a chemical raw material.

Organization of chemical manufacture. A few large companies, representing both vertical and horizontal expansion of former small companies, dominate the manufacture of chemicals in

the United States. The nature of the processes and the importance of patents make this an industry which could easily turn into a strong monopoly, did not our antitrust laws discourage it. The large investments make stable operations almost a necessity. The control of raw materials and the diversification of products are essential in obtaining stability of operations. Since the processes are continuous and usually require much time for their completion, concentration in one large factory is more economical than scattered operations.

Location of chemical manufacture. Generally speaking, either the location of raw materials or the ease of obtaining them by cheap transportation is the most important influence in locating chemical plants. In the case of electrochemical products, cheap power is the primary influence. The difficulties of transporting the finished products tend to place some of the industries near the expected market.

The manufacture of chemical products is widely distributed in the eastern half of the country, but production tends to concentrate at a few centers, of which the metropolitan area of New York is most important. While there is a great diversity in products, the tendency to concentrate on finished goods which require relatively little power is a general characteristic. Other centers are at Chicago, St. Louis, Buffalo, Philadelphia, Syracuse, Rochester, the Kanawha Valley of West Virginia, the Tennessee River Valley, and the Gulf coast in Louisiana and Texas. The Tennessee River Valley and other sections where large hydroelectric industries are being developed should have a promising future in the electrochemical industries. Buffalo now leads in the manufacture of electrochemical products, a large part of the developed energy at Niagara Falls being used for this purpose. These products are so important that their manufacture deserves extended treatment.

Electrochemical products. In manufacturing, electricity may serve three uses: (1) as a chemical agent, the process being called electrolysis, (2) as a generator of heat in a furnace, (3) as a source

of power for the mechanical processes involved in all manufacturing establishments. In the manufacture of aluminum it serves the first two uses, freeing the aluminum from the ore and at the same time keeping the ore molten. The electric furnace is important in the manufacture of electrochemical products, its principal advantage being that it can do things which fire cannot do. The only limits to the temperatures which can be obtained are the melting points of the materials from which the furnace is constructed. It permits the careful control of the quality of the materials and is free from smoke or ash, whose presence is a hindrance in making some products. The furnace may also be turned on or off at will. Mention of a few of its products will illustrate what it can do.

Limestone heated in an electric furnace becomes quicklime, which, when heated with coke, becomes calcium carbide. Sand, coke, salt, and sawdust heated together give *carborundum,* the chief abrasive used in metal working. Coke and sulphur electrically heated produce carbon disulphide, which is employed in the manufacture of most rayon. The manufacture of nitrogen from the air was described in Chapter 5.

The remainder of this chapter describes the methods of manufacture and the uses of some of the more important chemicals. The interdependence existing among various ones should be noted.

Sulphuric acid. Sulphuric acid, today the most important of the chemical raw materials, may be said to be the parent of the modern chemical industry. Someone has said that next to food it is the most indispensable material. There are two methods of manufacture. The acid used for the manufacture of fertilizer results from burning sulphur in a lead chamber with a regulated amount of air, water, and nitric acid, the latter having been made in the first place by treating saltpeter with sulphuric acid or by the oxidation of ammonia. The second method is employed when a better quality of sulphuric acid is desired: platinum, instead of

nitric acid, is used as a catalyst. In the manufacture of fertilizer, sulphuric acid is used to render soluble the phosphorus in phosphate rock, thus making it available to plants. To the pulverized rock is added about an equal amount of sulphuric acid.

Sulphuric acid plants are found in all the iron and steel centers, and in truck farming, tobacco, and cotton growing districts of the East and Southeast.

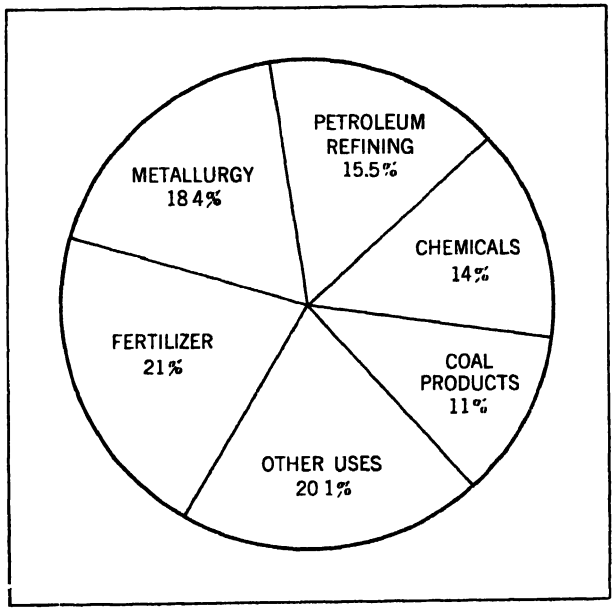
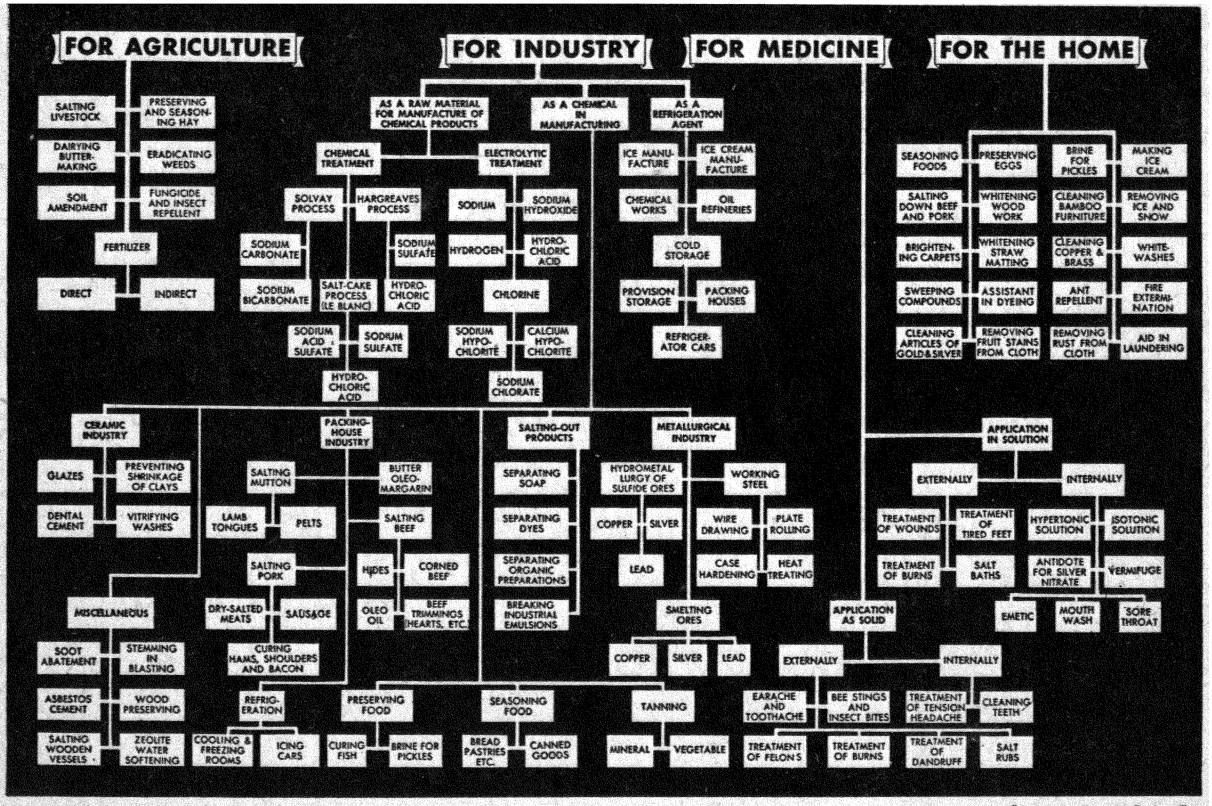


Fig. 122. Principal uses for sulphuric acid in the United States in 1936.

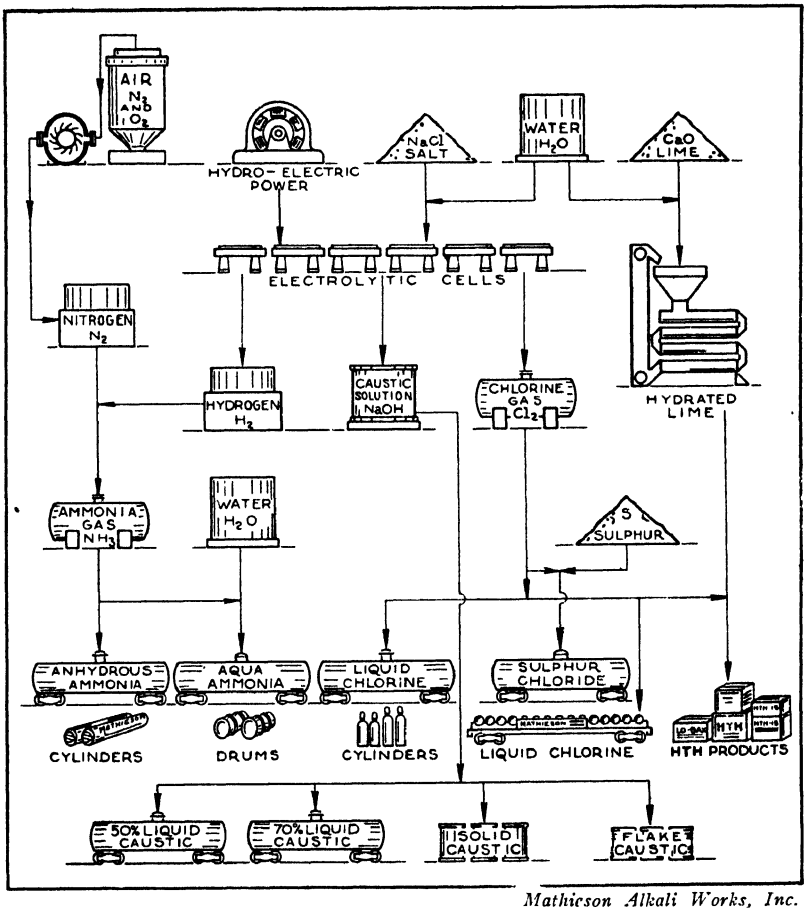
Alkali. The basis of the alkali industry is common salt, which is composed of sodium and chlorine. Soda ash and hydrochloric acid result from the treatment of salt with sulphuric acid. Hydrochloric acid contains chlorine, which, when released by chemical means and passed over hydrated lime, is absorbed by the lime to form bleaching powders. Salt, limestone, and ammonia also may be united to form soda ash and calcium chloride, the latter being used for refrigerating and other purposes. Chlorine does not result from this process. The newest process is to subject salt in solution to an electric current to form caustic soda and chlorine.



International Salt Co.

Fig. 123. Uses of salt.

The soda ash of the other processes may be turned into caustic soda by treating it with slaked lime. Chlorine for bleaching is now used chiefly as a liquid rather than as a powder. Two thirds of the output is used by the paper and pulp industry. It is also



Mathieson Alkali Works, Inc.

Fig. 124 Flow chart of electrolytic operations in manufacturing alkalies.

used to purify water, to bleach textiles, and for several other purposes.

The alkali industry is confined largely to the industrial area of the northeastern part of the country. Large deposits of salt are located in New York, Michigan, and Ohio, and the paper and

pulp, chemical, glass, textile, and petroleum-refining industries are important consumers. Important centers are at Niagara Falls, Syracuse, the Kanawha Valley, and southeastern Michigan. Recently factories have been built at Baton Rouge, at Lake Charles in Louisiana, and at Corpus Christi, Texas. The advantages of this section are transportation on improved waterways, plentiful supplies of raw material, and cheap fuel from the petroleum and natural gas of near-by fields. The principal markets in the region are the petroleum refineries, but they do not require a very large part of the potential production. It is thought that larger markets may develop in the Orient and in Latin America.

Alcohol. The term *alcohol* refers to a numerous class of substances. Recent scientific developments have made it one of the most important of chemicals, because of its use as a basic material in many other products. One of its most important uses is that of a solvent (a substance which dissolves another substance to form a uniform liquid). It is important in this respect in the explosive, lacquer, and varnish industries. It is indispensable in making smokeless powder and mustard gas. As a motor fuel it holds much promise, and factories, as yet experimental, are being built in the grain belt for this purpose.

Alcohol is obtained from corn, molasses, wood, and other vegetable products and may be made synthetically from natural gas and petroleum, blast furnace gas, acetylene gas, and a few other sources.

Coal tar. Coal tar results, along with other products (see Fig. 55), from the destructive distillation of coal. Although crude coal tar has several uses, its greatest value comes after further distillation, which produces 10 crude products. These, by exposure to the action of acids and alkali, are converted into more than 300 refined products. From these latter products by a series of complex chemical reactions, about 900 shades of dye are obtained. Several thousand different shades are known which could be made, were there sufficient demand for them.

Coal tar derivatives are the most important materials for mak-

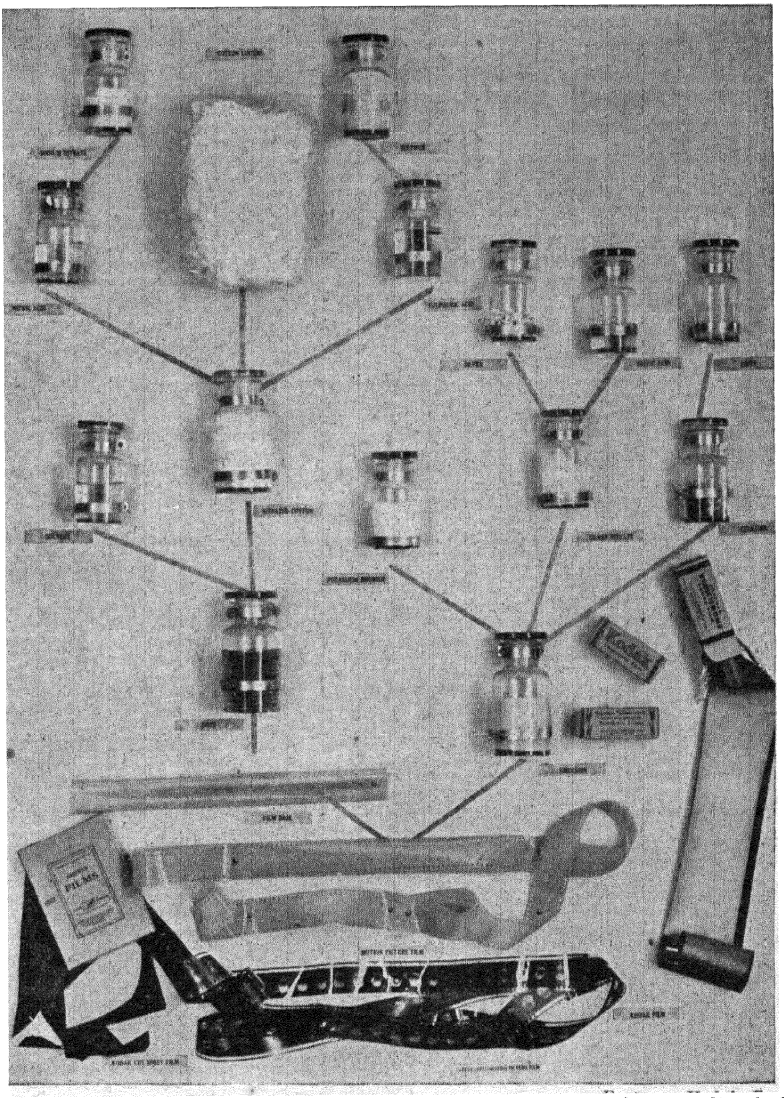
ing explosives. T.N.T. is obtained by treating toluene with nitric acid. Another explosive, picric acid, is made by treating carbolic acid with nitric and sulphuric acid. The manufacture of explosives is widely scattered because of the wide distribution of the mining and quarrying industries, which are the leading consumers, and because the products are difficult to store for long periods or to transport for long distances. The factories are usually located in country districts, so that in case of accident, the losses of life and property may be minimized. Wilmington, Delaware, is the center of administration for the industry, the office and banking center for large corporations engaged in the manufacture of explosives.

Coal tar is extracted largely in the coal mining and the steel manufacturing centers. Albany, Newark, and Buffalo are important dye manufacturing centers.

Cellulose. Paper, rayon and allied products, celluloid, and some explosives have their origin in cellulose, the structure of every growing plant, which makes up over one third of dry vegetable matter. For the manufacture of cheap newsprint, pulp, to which chemicals have not been added, may be used, but in the manufacture of the better qualities of paper and other products mentioned above various chemicals must be used. There are several methods for making chemical pulp for paper and rayon and allied products, but the sulphite process is used most. In this method the chief chemicals employed for treating the pulp are sulphuric acid and lime. Sulphite pulp is almost pure cellulose.

Celluloid, one of the leading plastics, has its origin in nitrocellulose, which is cellulose treated with nitric acid. The nitrocellulose is reduced to a paste by a solvent, after which camphor is added. Nitrocellulose is also the main raw material used in making smokeless powder. It is used for film, artificial leather, and lacquers. In making the latter it is dissolved with alcohol or a petroleum by-product.

Foreign commerce in chemical products. Our annual foreign commerce in chemicals has ranged recently from $175,000,000 to



Eastman Kodak Co.

Fig. 125. Chemical processes in the manufacture of photographic film, and some applications. The various products involved in the making of photographic film are:

Cotton linters.	Silver.
Sodium nitrate.	Silver nitrate.
Nitric acid.	Potassium bromide.
Sulphur.	Hides.
Sulphuric acid.	Gelatine.

about $200,000,000, or about 10 per cent of the total foreign trade. Previous to 1929 the exports and imports had been about equal in value. Since then, however, exports have been increasing rapidly and are now about 50 per cent greater than the imports. Trade agreements, the expansion and increasing maturity of the chemical industry, and the rearmament programs of many countries probably account for this growth of exports, which has been particularly important in the case of coal tar, phosphate rock, paints, and soap, which, with sulphur, alkalies, naval stores, and medicines, are our leading exports of chemicals. About 5 per cent of the total chemical output is exported. The leading imports are industrial chemicals and fertilizer materials.

The important market for exports has been Canada, which takes about one sixth of the total. The United Kingdom buys about half as much as Canada, followed by the Caribbean region, Japan, Hawaii, and Switzerland. From 20 to 25 per cent of the imports recently have been from the German Reich, which, incidentally, enjoys 60 per cent of the total foreign commerce of the world in chemical products. The United Kingdom and the United States have about an equal foreign trade in these commodities, with France only a little less important. Other important sources of our imports are Chile and Switzerland.

21

TRANSPORTATION EQUIPMENT

Features of transportation equipment industries. The importance of transportation to American industry was discussed in Chapter 1. To move our immense amount of traffic, an enormous investment in several kinds of equipment is necessary. The different kinds of equipment for railroad, highway, water, and air transportation have certain features in common. First, they are all fabricated or assembled products, largely of metal. Secondary raw materials are assembled into the finished product. Some of the companies are integrated, however, and produce their materials through several of the stages. Another feature is the standardization of types in each industry except the making of ships, and during the World War standardized ships were found to be more economically constructed than the individual types. Again, most of these products can move to market under their own power if necessary, or, in the case of railway cars, can be put into trains and delivered to the purchaser at low cost. Automobiles, however, are shipped chiefly by rail. Another common feature is the importance of repairing and servicing, which has caused the rise of a large number of centers and businesses to do the work. Finally there is the importance of technical skill and scientific research. These have been responsible for the present state of near perfection, and future progress depends upon them more and more. Each type, begun as a small crude piece of machinery, has been brought to its present state through gradual improvement, and immense sums of money are still being spent to find improvements which will further reduce the cost of transportation.

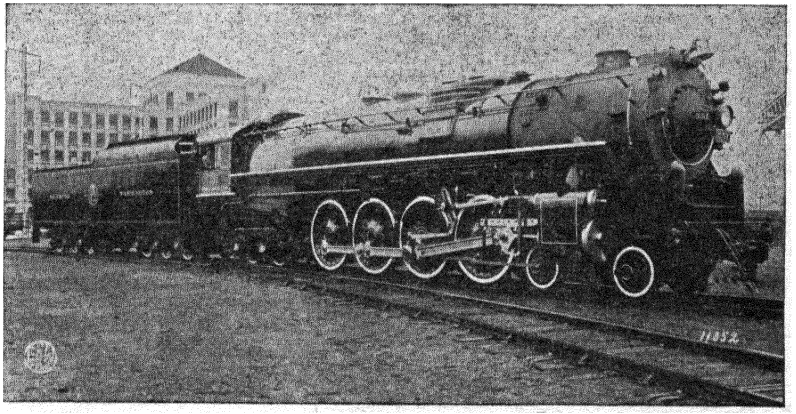
RAILWAY EQUIPMENT

Types. Railway equipment consists of locomotives, both electric and steam, Diesel and gasoline motored power units, and many different types of freight and passenger cars, each type being devised to meet a particular need. Cars are made of both metals and wood. The tendency has been toward a greater use of steel cars, with a consequent shift of car manufacture from the locations near supplies of lumber to the steel centers. The average freight car is heavy, the deadweight which the locomotive must pull being as much as or more than the paying load. The future, therefore, will probably see the use of an increasing number of cars built of light alloys instead of steel. Though the present power equipment can generate much greater average speeds than it now does, rails, as now built, would be damaged seriously by heavy equipment traveling over them at high rates of speed. There also may be an increasing use of the electric locomotive. Its introduction has been slow because of the large investment in steam locomotives and because of power problems. The equipment operated by internal-combustion motors usually has been for passenger service on branch lines and by small companies; but Diesel motors, as used in the new high-speed passenger trains, are changing this situation.

Centers of manufacture. Philadelphia is the leading center in the world for manufacturing locomotives, but New York leads among our states, Schenectady being the leading center. Others are Lima, Ohio, and Pittsburgh. The few centers are located near steel districts.

There is a tendency to locate factories for railway cars at great railway centers like Chicago and St. Louis because of marketing advantages. Chicago is the home of the Pullman car factory, and St. Louis ranks high in the manufacture of cars for steam railways and, with Philadelphia, manufactures most of the electric and trolley cars of the country. St. Louis, being near to both hardwoods and southern pine, had its start when cars were made of wood; but

it also has a rising steel industry and thus tends to maintain an important position. The low cost coal of high heat value which is available from southern Illinois aids in this respect. Steel cars, however, are manufactured chiefly in the eastern steel centers, particularly at Pittsburgh. Philadelphia manufactures the majority of the new aluminum passenger trains. High quality of materials and workmanship are both essential, and these are more likely to be found around centers which are noted for a high quality of metal products. The foresight of individual manufacturers was probably another factor in locating this industry.



Baldwin Locomotive Works.

Fig. 126. Modern locomotive suitable for either fast freight or heavy passenger service.

AUTOMOTIVE EQUIPMENT

Importance. The investment in highways and the equipment which operates over them is greater than that in the railway plants of the country (29 billion vs. 26 billion dollars). Automotive transportation is recent, but its rise has been rapid. Most important is the private automobile, but the truck and bus have developed much traffic for themselves, a great deal of it at the expense of the railroads.

The manufacture of automobiles, normally the leading manufacturing industry, is particularly important to the prosperity of

the nation. This is true because it is an important market for many products and services, being the leading consumer of steel, plate glass, nickel, lead, mohair, and rubber, and because it employs a large number of workers at relatively high wages. The selling of the products and the financing of the sales are other important activities.

The United States leads the world in the use of automotive equipment because of the (1) high standard of living, (2) willingness of the people to travel, (3) long distances, (4) large area of level country, a factor in low operating cost, (5) cheapness of motor fuel, and (6) willingness of the buyers to accept a standardized product which is inexpensive because of the employment of particular methods of organization and production.

Reasons for low unit costs. Unit costs are low because of the principle of mass production, which has been made possible by standardization, accurately made, interchangeable parts, and the progressive method of assembly—all of these making possible a detailed division of labor with its resulting high degree of specialization.

Organization of automotive manufacture. There are three steps[1] in the manufacture of an automobile: (1) the manufacture of the raw materials into parts, (2) the assembly of the parts into nine primary units, and (3) the assembly of the units into the complete car. The last two steps take place in the automobile plant, although some of the primary units, for example the motor, may be assembled in separate plants and then shipped to those plants where they are assembled into the completed car.

At first, automobile plants were small, but keen competition has caused the rise of large companies; either by expansion of the original plant, or by merging several plants into a rounded organization. Originally, automobile factories only assembled, depending upon other industries for parts; but as the size of the plants increased, it became necessary and economical for them to make an increasing number of the necessary parts. At least one

[1] J. G. Glover and W. B. Cornell, *The Development of American Industries*, New York: Prentice-Hall, Inc., 1932, p. 645.

company is now a completely integrated concern, even including the manufacture of tires. Some automobile companies make accessories and parts to sell to other automobile manufacturers, while there are many companies that make accessories and parts, but do not make complete cars.

Centers of manufacture. The Detroit area manufactures over half of the automotive equipment of the nation, and the industry contributes more than half in value of the total manufactures of Michigan. Other centers are South Bend, Indianapolis, Toledo, Cleveland, and Buffalo. One should note the concentration in a rather compact area, located centrally relative to population and centers of other industries. A central market location is important because of the practice of having the purchaser pay the freight charges instead of having the manufacturer sell at a delivered price.

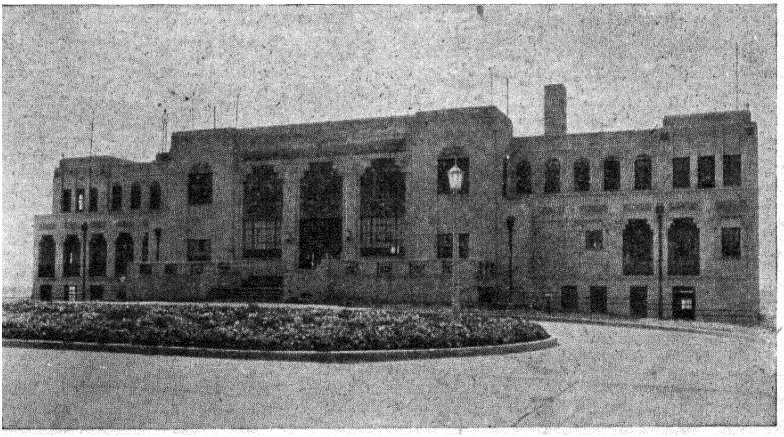
Other influences favoring the Detroit district were the iron ore, copper, and lumber of the upper Lakes region and location on water, where all of the necessary materials could be assembled cheaply; the presence of foundries, machine shops, and vehicle factories, which provided a supply of skilled labor and various accessories; and the willingness of local bankers to finance the factories. This latter seems to be a characteristic of midwestern bankers, and although it often results in a good deal of financial trouble for the country, it has resulted in the rapid development of several industries. Early automobiles were made in wagon and carriage plants. The same materials were used in either case, and because the automobiles were assembled, the work could be done easily in vehicle factories. A number of present companies are continuations of those begun by wagonmakers.

The factories which make automotive accessories cluster about the places where the equipment is assembled, although they may not be in the same cities. Akron is the leading manufacturer of rubber tires and tubes. This is probably another illustration of accidental location, although the city does have water power. Anderson, Indiana, is an important center for the manufacture of

a large line of accessories, such as ignition systems, horns, and minor products.

AIRCRAFT

Rise of air transportation. There are two types of aircraft, the dirigible and the airplane, the one lighter than air, the other heavier. The former is of no commercial importance in the United States, but the experience of Germany proves that it has



Wichita Chamber of Commerce. Photo by A.E. Spalton.

Fig. 127. Administration Building, Municipal Airport, Wichita, Kansas. Note weather instruments on roof.

possibilities. Some people think that eventually dirigibles may be used to carry passengers and freight over trunk routes, with airplanes used as feeders over lateral routes and branches at the ends of the trunk route. In the United States dirigibles are used for military purposes, and not even all of those used were built here. The center of manufacture in this country is Akron.

The airplane industry got its first impetus during the World War, and even yet its development has been largely because of the military need for planes and trained personnel. Practically every government in the world has subsidized its airplane industry either by mail contracts or outright subsidies.

In the United States the airplane industry went almost bankrupt

after the War, but in time spectacular flights, education of the public and its air-mindedness, and improvements in the design and construction of airplanes to increase safety and economy of operation combined to expand the market, but there is still much excess capacity in the industry. Since about 1928 there has been a rapid growth of all types of air traffic. This is because of decreased operating costs and the depression, both of which caused lower rates, and added experience in organizing and operating the facilities.

Centers of manufacture. There are two divisions of airplane manufacture, namely the manufacturing and assembling of the parts of the motor and the assembling of the finished airplane. Centers for motor production coincide with those of automobile production. The first centers for the assembling of airplanes were Dayton, Ohio, and Hammondsport, New York. At present, Los Angeles is the leading center. Other centers are Seattle, Detroit, Buffalo, East Hartford (Connecticut), and Wichita (Kansas). Central location in the plains along a transcontinental air route has caused the growth of the industry in the latter city. For convenience, repair centers for airplanes locate centrally on routes or at their terminals, and it is logical that manufacturing centers should grow where repairing is done. Repairs are an important item of cost, for about one third of the planes of important companies are out of order all the time. Since the industry may be conducted on a small scale without large capital, it is possible for local influences to attract it to many localities.

SHIPBUILDING

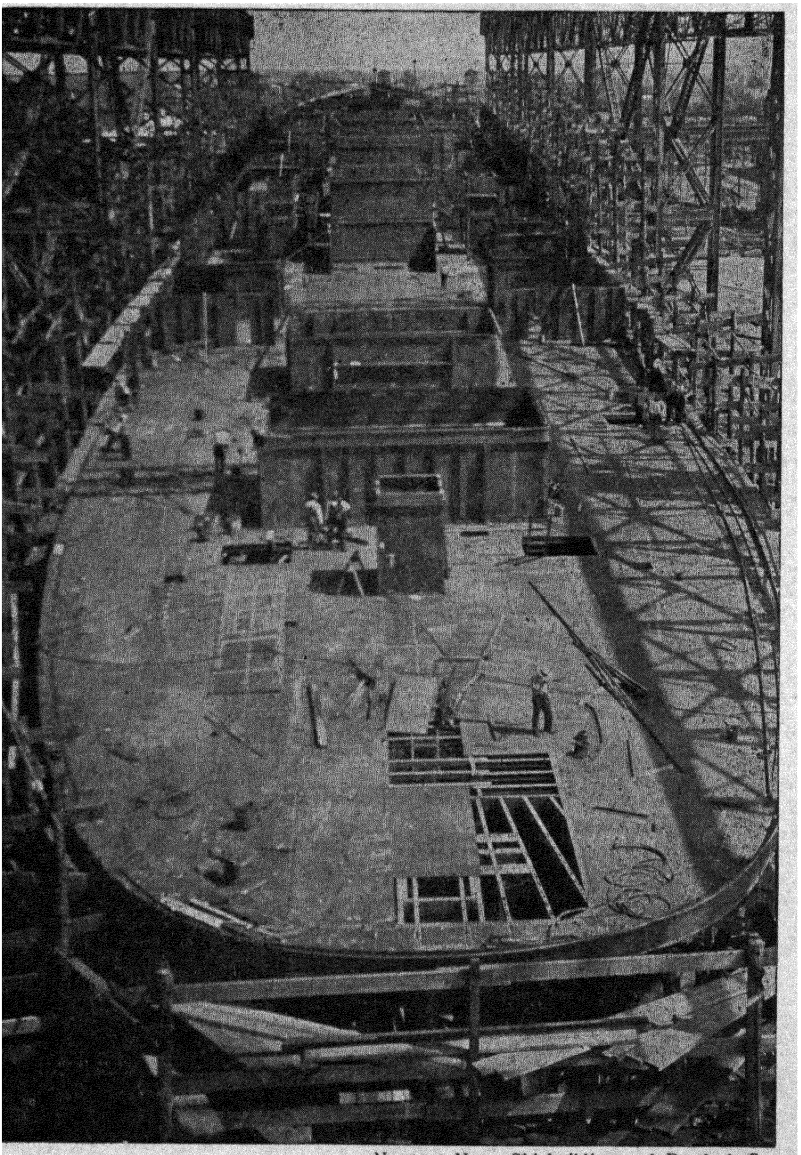
Historical influences. During the later days of the wooden sailing vessel the United States was supreme in shipbuilding. But with the rise of the iron steamship about 1850, in the building of which the skill and experience of the British in the working of iron gave them an advantage, and because of the opposition of the South and the West to ship subsidies at that time, the industry started to decline. The Civil War and subsequent events, how-

ever, dealt the crushing blow. Many ships were sold abroad during that conflict, while others were sunk by Confederate privateers. After the war the government abandoned its policy of granting aid and in addition enacted unfavorable registry laws and gave materials for shipbuilding protection under the tariff laws. Various events also were turning attention more to internal developments, where greater profits were to be made. All of this so discouraged the building and operation of ships that by 1914 only ten per cent of our foreign trade was being carried in our own ships. Under the stimulus of the World War our government built a merchant marine, and since then has tried to encourage with mail contracts and subsidies the building and operating of ships. Protective tariffs on shipbuilding materials and laws relating to the operation of our ships increase the operating cost of ships flying the American flag so much that it is difficult to compete with the ships of foreign countries; and our registry laws prevent any but American-built ships to fly the American flag.

Many ships are built in this country for river, coastwise, and lake transportation, all of these routes being reserved to American ships by law, but with the exception of the ore ships on the Great Lakes, they are chiefly small craft.

Location of shipyards. Deep water and the location of materials largely locate shipbuilding. In the days of the wooden vessel New England was important, but with the rise of iron and of steel ships, the industry shifted to the Middle Atlantic coast. This is also where there is the greatest demand for ships; all of the important seaports and lake ports have some shipbuilding because of the local demand.

The district around New York City, with the great expanse of water and large amount of shipping, leads in building ships. The largest shipyard there is at Kearny, New Jersey; but Brooklyn, Newark, and other places also have large yards. The second most important district is the Philadelphia area along the Delaware River, called the American Clyde. The leading yards are at Camden and Chester. Next is the Chesapeake Bay area with impor-



Newport News Shipbuilding and Drydock Co.

Fig. 128. Ship under construction.

tant yards at Newport News, Baltimore, and a government shipyard at Norfolk. Although these southern locations have a winter advantage over the northern ones, they are more distant from the iron and steel and machinery-manufacturing centers. The shipyard at Quincy, Massachusetts, is among the larger ones of the country, and there is a government yard at Portsmouth. The Pacific ports all have shipbuilding industries as do also the large Lake cities, particularly those along Lake Erie. The specialized nature and the size of many of the ships used on the Lakes require that they be built there.

For the average ship built in the United States, about 40 per cent of the cost is for the labor, a little more than 50 per cent for the materials, and the remainder for taxes, insurance, and other items. Of the amount spent for materials, about 35 per cent is for machinery, 27 per cent for structural iron and steel, and half as much for products made of other metals, and the remainder for a long list of articles necessary to equip the ship and put it in running order.

EXPORT TRADE IN TRANSPORTATION EQUIPMENT

The qualities of our transportation equipment and the existence of several countries industrially new or undeveloped, that are either near by or have transportation problems similar to our own, have caused an important export trade in this equipment. Most of these countries are large and do considerable exporting, which requires railway equipment for hauling products to the seaports. There are also sparse populations which are engaged in the production of types of commodities which yield a high per capita income, making these countries good markets for automobiles and for airplanes. The people of the mountainous parts of Latin America live in isolated communities which cannot be connected easily with the outside world by rail, but which are connected by air routes that handle a large amount of passenger traffic. At present our exports are largely automotive products, but in the past, large quantities of railway equipment were sold. The de-

velopment of highway transportation the world over has created a heavy demand for our automotive products because of the engineering skill which enters into their manufacture in combination with their low price, which is a feature of all of our transportation equipment. The low price results from making standardized products by mass production methods.

At present automotive equipment amounts to 10 per cent of our total exports, and about 10 per cent of the total output of that industry is exported. The best markets are the countries of Latin America and the more advanced divisions of the British Empire—South Africa, Canada, and Australia. The two groups now buy more than half of the exports of automobiles, the British countries being a little more important than the others.

22

ELECTRICITY

ELECTRICITY is not a source of energy but only an agency for applying the energy contained in power resources. It is thus a secondary force, and it may be called energy itself.

Expansion of use of electricity. Though the electrical industry depends on some basic discoveries and inventions made more than a century ago, as a practical business proposition it dates only from

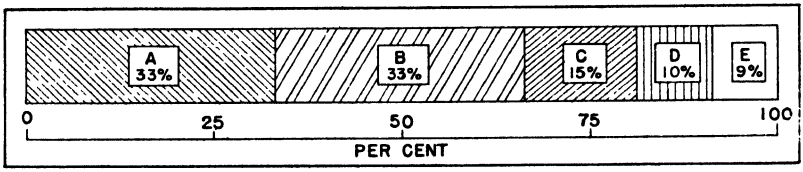


Fig. 129. Regional distribution of electricity made from all sources in the United States. A—Northeast, B—Midwest, C—Pacific region, D—Southeast, E—others.

1882, when Thomas Edison built the first central station in the world in New York City to furnish power for the use of the incandescent light, which he had invented in 1879. This invention is commonly accepted as marking the inauguration of the trend which has often been characterized as the Age of Electricity. In 1882 Edison also built the first hydroelectric station at Appleton, Wisconsin.

The production of electricity by public utility power plants has increased from 5 billion kilowatt-hours in 1902 to 43 billion kilowatt-hours in 1920 to 109 billion in 1938. At present more than 85 per cent of the industrial plants of the nation are electrified. There are 28 million consumers of electricity, 75 per cent of the people live in homes that are lighted with electricity, and above

one million farms are served with electricity. There is an investment of above 14 billion dollars in the generating industry, and in 1938 the gross income was about $2\frac{1}{5}$ billion dollars. During that year the price of electrical energy was the lowest for any extended period in the history of the nation, the domestic rate being 4.20 cents per kilowatt-hour, compared with 6.3 cents in 1929 and 7.56 cents in 1920, while the industrial rate was 1.23 cents per kilowatt-hour in 1938, compared with 1.38 cents in 1929, and 1.89 cents in 1920. Between 1920 and 1938 the use of electricity for domestic purposes increased 6.2 times, and for industrial uses, 2.20 times. In 1938 there was 20 per cent more production of electrical energy than in 1929, and during the interim the horsepower of electrical motors had increased 33 per cent. In 1937 it was estimated that the per capita use of electricity in the United States was 4 times the average of that for the remainder of the world, and the general rising trend promises to continue for years to come.

Advantages versus disadvantages. Compared with other methods of applying energy, electricity has several advantages. It is clean and convenient, being applicable instantly at the turn of a switch. Its availability in any quantities and its transportability have made mechanization possible for small-scale industry. As a result industry has given indications of decentralizing, an important economic and social consideration. Most of the electricity is used now within a few miles of where it is generated, but it can be transported economically for much longer distances, and progress is being made in still longer distance transmission. Another advantage is the many different purposes for which it can be used—for lighting, heating, as a chemical agent, and other purposes. Finally, since it may be generated from several materials, some of them waste or by-products, it is, therefore, a factor in the conservation of energy resources.

The only important disadvantage of electricity is that it cannot be stored in large quantities. An independent plant must be large enough to meet the peak load, which may result in much unused capacity at times. These difficulties may be overcome to a large

extent by storing water in reservoirs, by using different types of plants to supplement each other, and by interconnection among different systems.

The sources of electricity. Some people think that all electricity is generated from water power. In the United States only about 40 per cent of the supply has its origin in this source, the remainder resulting from the burning of fuels, chiefly coal. The tendency recently has been toward the installation of relatively more steam equipment. In 1912 steam installations were 53 per cent of the total and hydroelectric 47 per cent; in 1938 the proportions were 74 per cent and 26 per cent respectively. At present over 60 per cent of the central stations and 90 per cent of the industrial stations use steam. Of the amount produced by use of fuels, coal contributes about 83 per cent, natural gas 14 per cent, and petroleum 3 per cent.

The factors that affect the choice of a source of power are: "location, costs of various types of fuels, size of the required installation, degree of reliability of service required, availability of water power sites, availability of condensing water supply, cost of purchased power and use of process steam." [1] The implications of some of these factors become evident in the two following sections; others may require a word of explanation here. A supply of water to condense the steam exhausted from the turbines is important, the quantity being so large that it is often a major factor in locating steam plants. A plant of 100,000 kilowatt capacity requires 500 tons of water per minute.[2] Normally, about 1,000 tons of water are used for each ton of coal burned. In the manufacture of some products, for example, flour, rubber tires, or veneer for furniture, steam is necessary for some of the processes. Although some public utilities sell both power and steam, a company requiring steam in its processes might find it profitable to operate its own steam plant.

[1] J. D. Justin and W. G. Mervine, *Power Supply Economics*, New York, John Wiley & Sons, Inc., 1934, p. 12.

[2] *Ibid.*, p. 53.

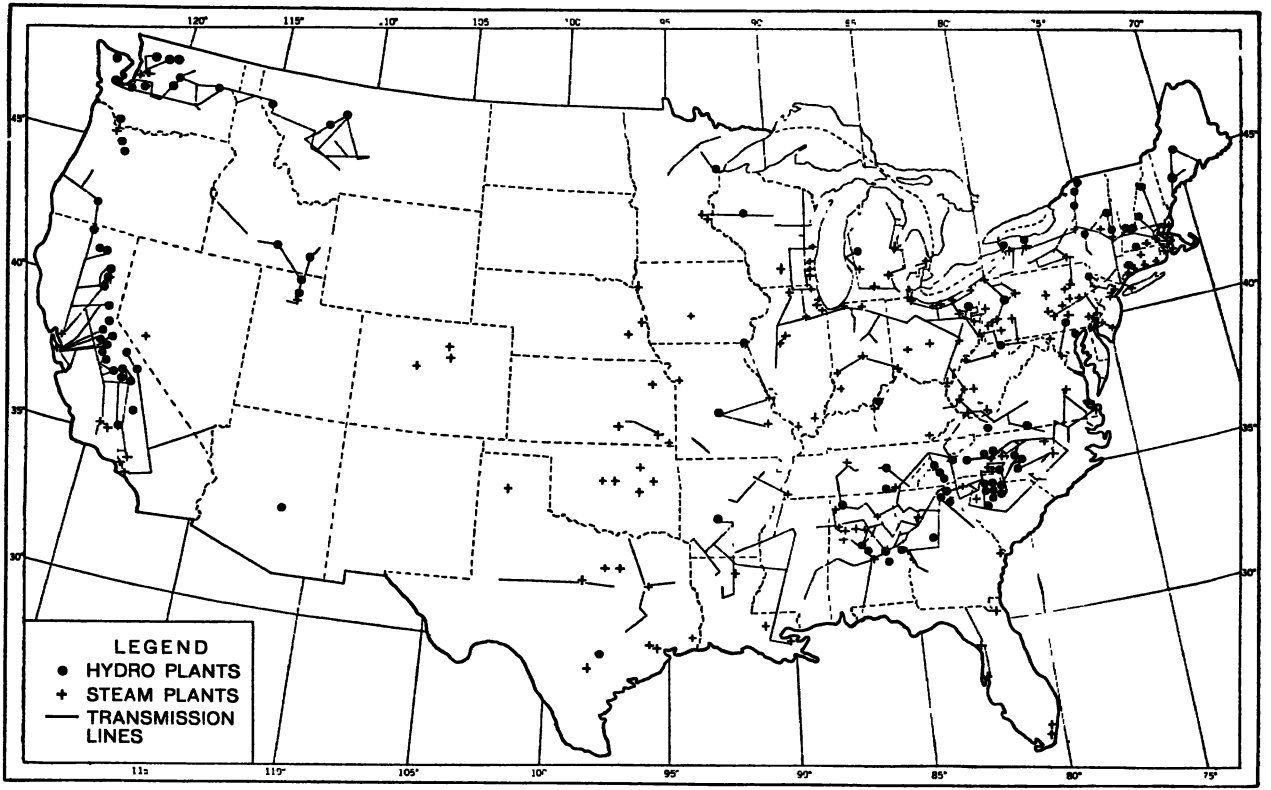


Fig. 130. Approximate location of electric generating stations of a capacity of 25,000 kilowatts or more and of transmission lines of a capacity of 100,000 volts or more. (After a map by the National Resources Board.)

Steam versus hydroelectric power. In the United States steam plants have generally been more economical than hydroelectric plants. The latter make cheap power where a large plant can be built and operated continuously. Hydroelectric plants cost from $200 to $500 per horsepower to build, and steam plants only $100. The operating costs of the latter, however, are higher. Thus, while the capital costs of a hydroelectric plant are high, the operating costs average about 11 per cent of those of steam plants. Most of the costs continue in hydroelectric plants whether they are operating or not; the steam plant can reduce its operating expenses a considerable extent, according to the demand.

As was stated previously, relatively more steam equipment is now being installed. One reason for this is that the best water power sites have been developed. Those remaining are isolated, and the construction and operation of plants are therefore more costly. Another reason is the increased efficiency of steam plants in the use of coal. In 1920 each kilowatt-hour of electricity required 3 pounds of coal; in 1935 this had been reduced to 1.46 pounds, and the twelve most efficient plants of the nation used less than one pound. Even now the best steam plants range from only 25 to 35 per cent efficient, leaving a wide margin for increased economy of operations. Hydroelectric plants are 90 per cent efficient. Much of the recent advance in steam plants has resulted from higher pressure and temperatures, which have been made possible by new metal alloys. Temperatures of 900° to 1,000° are now obtained, and pressures of 1,800 pounds. Many plants develop 1,400 pounds of pressure.[3] There have also been improvements in stoking.

Where large loads exist, it is often economical to have a combination of the two types, using the steam plant to furnish the base load (the constant minimum amount of energy needed) and the hydroelectric plant to supply the peak load (demands greater than

[3] For the source of the figures in this paragraph, see G. W. Gray, "Full Steam Ahead," *Atlantic Monthly*, 159:118, 123.

the base load), which it can do at low cost. Steam peak-load plants are expensive to operate. A hydroelectric plant may be started instantly, but a steam plant cannot unless it is kept ready for operation almost continuously. It is therefore necessary to operate a steam plant at maximum capacity for economical results. In some places, however, where the flow of streams is uniform, the hydroelectric plants may be used to furnish the base load, and steam plants, the peak load.

Steam plants, known as "stand-by" plants, to furnish the minimum load needed in time of emergency, are also a necessity with most hydroelectric plants. The hazards associated with hydroelectric plants are such that complete dependence upon them by essential industries or for cities service involves too great a degree of risk. Stand-by plants may also be used to furnish an occasional peak load.

Internal-combustion motors. Internal-combustion motors are not important for providing industrial power, but there is an installation of about 3,000,000 horsepower in other than transportation equipment, a considerable part of which is in manufacturing. They are desirable in small plants when process steam is not needed, in isolated sections where the demand for power is light or where sources of power other than petroleum are lacking, in places where condensing water for steam plants is not available, and in many municipal power plants. They also are often economical in furnishing seasonal or short-time loads. Their costs do not all continue as they do in idle steam plants. They are often desirable, too, because of their high operating efficiency when there is a 24-hour demand for energy.

Organization of the electrical industry. There are 3 groups of industries within the electrical industry: (1) those which generate the electricity, (2) those which manufacture the various kinds of equipment for generating, transmitting, and consuming electricity, and (3) consuming companies, such as those in the communication industry and electrically operated railways. There are

also many independent distributors of electricity which stand between the large generating companies and the final consumers. Generating companies sometimes own consuming companies in order to be certain of a market sufficient in size to make economical generation possible. There are also often close commercial relationships between the manufacturers of equipment and the communication industries, resulting from the control of patents. Then there are large holding companies which unite under a single control the activities of many generating or many distributing companies. To a degree at least, such companies are able to obtain economies through larger scale operations, interconnections, and the advantages which result from the ability to command large amounts of capital. In 1937 about 90 per cent of the public utility industry was controlled by 57 firms. The entire electrical industry of the United States is estimated to have an investment of roughly 35 billion dollars.

The manufacture of electrical equipment. The rise of the electrical industry has resulted in large companies to manufacture the many types of necessary equipment. There were originally many small companies, but they have been merged until now a few large concerns dominate the field.

Mergers brought men of scientific ability and men of organizing ability together. Both types are necessary, because this dynamic industry is built upon a foundation of discovery and invention. New devices to expand the consumption of electricity are being invented continually, and there is a constant attempt to expand into new fields. Products are made, as in the chemical industry, before there is a demand for them; their market has to be created. Both research and development of markets require large outlays of funds which can be provided easily only by large firms. It is in this connection that organizing ability becomes necessary.

Patent rights are extremely important, and they are usually owned by the few companies which manufacture the electrical equipment. The control of patent rights and the large invest-

ments necessary to conduct research and to construct plants in the generating field create conditions favorable for monopoly.

Although only a few companies manufacture equipment, their plants are widely scattered. They tend to locate near the markets. Among the leading centers are Schenectady, Pittsburgh, Chicago, and Cleveland.

GIANT POWER

Meaning and implications. "Giant power" means the central generation of electricity in large plants for distribution over wide areas, and the interconnection of the different plants in a region. By such organization it is possible to shift the load in the direction where it is most needed at the time. The power resources, thus pooled over large territories, make it possible to care for emergencies on local systems, created both by breakdowns and by demands for power they are not equipped to meet, and to obtain economies of operation. Interconnection refers not alone to public utility plants but also to the power plants of private manufacturing concerns which may have surplus power at times. At present manufacturing plants generate about half of the power they use, and buy the remainder from central stations. Another feature is the generation of much of the energy as near the site of the power resource as possible.

Advantages. Many advantages would spring from these interconnected systems. Since the energy is to be distributed as electricity, there would be all of the advantages claimed for electricity earlier in this chapter. The generation of the power in large plants near the energy resource would help to conserve the resources and to reduce the unit cost of power. Energy resources would be conserved by the supplementing of one by the other, by the greater efficiency with which large plants utilize coal, and by the elimination of much hauling of coal by the railways, thereby saving fuel and economizing in the use of railway plant and equipment as well.

The unit cost of power would be lowered because less capital

investment per unit of output would be required, owing to the more constant use of the facilities. A large plant has a better load factor than the several small ones which it replaces, because it supplies a greater variety of markets, and none of the great demands for power occur simultaneously; interconnection increases this advantage. Independent plants, because of the need for sufficient capacity to supply their peak load, must leave some of the equipment idle a portion of the time. This is expensive because the unit cost of power under a high load is only a fraction of that under a low load. Interconnection makes it possible to care for individual fluctuations without causing fluctuations in the entire system. As a result a more constant operation of the plants near their maximum capacity is possible. It should not be supposed, however, that interconnection will permit even operation throughout the 24 hours of the day. The night load required is normally only a quarter of the day load. Other advantages of interconnected systems are greater reliability of service for the consumer and a simplification of the problems which the power companies meet in developing larger markets for electricity.

An example of giant power. A giant power project was planned for the northeastern United States several years ago. Provision was made for two steam plants in the anthracite region, one at Pittston to serve the northern anthracite region and the New Jersey manufacturing area, the other at Sunbury to provide power for the Reading and Philadelphia districts. The plant at Pittston is to be supplemented with hydroelectric power from the upper Hudson Valley, which would also serve the Mohawk Valley, while the power of the Delaware and the Susquehanna Rivers is to be developed at the Fall Line to supplement both steam plants. The power of the Potomac is to be used in the Baltimore-Washington area. There also are to be steam plants near Boston and New Haven, these points being able to obtain cheap coastwise coal. Thus has provision been made for the coördinated use of the power resources to supply dependable, cheap energy to the manufacturing plants of the Middle Atlantic region and lower New

England. Another such project might utilize Pittsburgh coal and the water power at Niagara, and still another the coal of southern Illinois and the water power of the eastern Ozarks and at Keokuk, Iowa.

The national power development program. The Federal Government is engaged at present in the development of several large hydroelectric projects which will be capable of supplying energy over large areas, and which may result after considerable time in

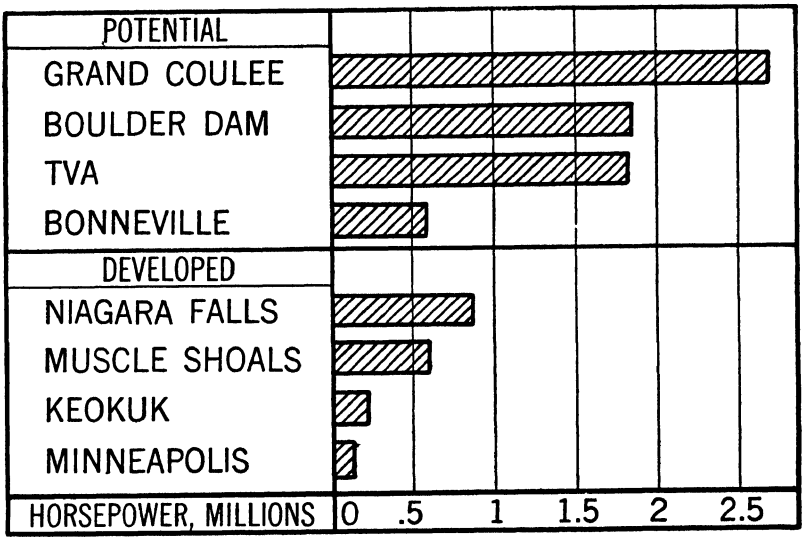


Fig. 131. Potential and developed water-power energy at selected sites in the United States.

a much changed national energy and industrial organization. These are integrated programs, and although in the majority of them the chief consideration is power, they are what some authorities have called "multiple-service projects." Flood and erosion control, reforestation, navigability of streams, irrigation, and the fullest economical utilization of the resources of a region are other considerations. Such undertakings contain interesting possibilities, but they are so vast and are confronted with such problems and uncertainties that private enterprise is not willing to undertake their development. There are advantages to be gained by

making them as inclusive as possible, and it is not likely that companies interested solely in the development of power would be willing to make the necessary expenditures for providing the other services. One problem of integrated projects, and seemingly a difficult one where there is competition with private industries, is to allocate the costs properly to the different services. A private project, developed solely for power purposes, must meet its costs

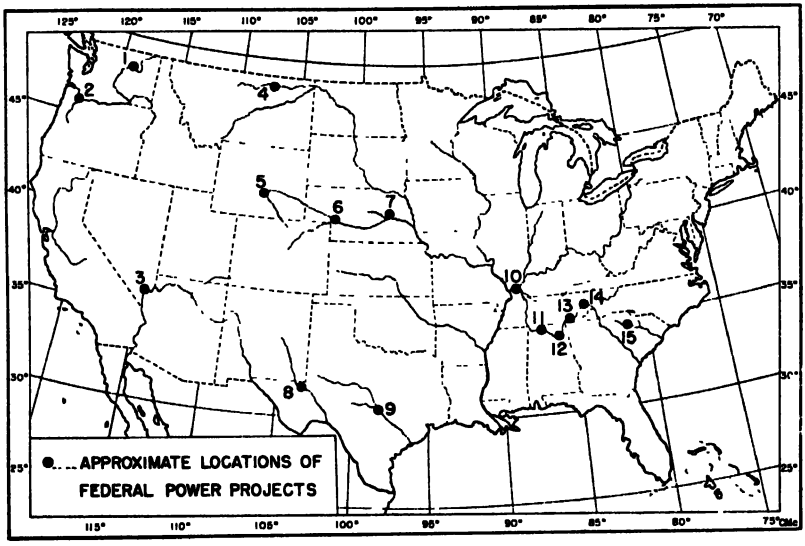


Fig. 132. Federal Power Projects. (1) Grand Coulee, (2) Bonneville, (3) Boulder Dam, (4) Fort Peck, (5) Casper-Alcova, (6) North Platte, (7) Loup, (8) Pecos, (9) Colorado, (10) Aurora, (11) Wilson, (12) Joe Wheeler, (13) Pickwick, (14) Norris, (15) Saluda.

from the sale of power. A government project, developed for several purposes, need not allocate the entire cost to a single service; and to determine the exact proportion for each service is difficult. A portion of the expenditures, such as in the case of reforestation and flood control, is for general welfare, is paid out of taxes, and would be made in many cases regardless of the other services. When hydroelectric power is provided also, should the principles of cost accounting, which are used by the private power companies, be followed in determining the price at which it is to be sold? Is there any common basis for computing and compar-

ing costs? Some people think that the method of allocation used by the government is improper and unfair to the private enterprises; others think that these multiple service projects are a new and separate type of economic institution which will have a definite place in the future, and that they cannot and should not be looked upon as a type of institution that is parallel with the private companies. In dealing with this problem there is certainly the necessity for careful scientific research and a judicial attitude in applying facts to policies and practices.

The purpose of some of the public projects is to have a measuring rod by which to determine what is a reasonable price for electricity. This product is of major importance to human existence in a modern society, and the feeling is widespread that its cost to the consumer has been much too high.

23

ALASKA AND THE PACIFIC POSSESSIONS OF THE UNITED STATES

ALASKA and our scattered island possessions in the Pacific are important enough to us to merit attention. The primary purpose for including these possessions in our discussion is to observe the integral part which they play in the affairs of our nation. For this reason, they are studied as units, and a shift, therefore, must be made from the industrial-commodity basis which has been employed thus far to the country-regional basis.

This chapter includes Alaska, Hawaii and near-by Kure Island, Wake and Midway Islands, Guam and American Samoa, and Howland, Jarvis, and Baker Islands (Fig. 133). The Philippines, because of their physical similarities with southeastern Asia and the East Indies, are included in Chapter 41 with those countries. Furthermore, the Philippines will gradually pass from our control, since they recently have been assured of their independence, which, according to present plans, is to become complete in 1946.

The sizes of these possessions range from that of Alaska, which is 20 per cent as large as the United States, to that of some of the smaller islands, which are only a few square miles in area. The population ranges from about 400,000 in Hawaii to only a few government workers on some of the recently acquired islands. Alaska has about 60,000 people, half of whom are Indians and Eskimos.

Although some of these possessions have become of considerable commercial importance, they have, on the whole, been acquired because of their importance in our scheme for national defense.

Some of the recent acquisitions have no particular military importance, since we possess other more strategically located islands; but they are valuable for landing fields in the development of transpacific air navigation. Alaska and Hawaii are territories of the United States, and therefore each has a separate governmental

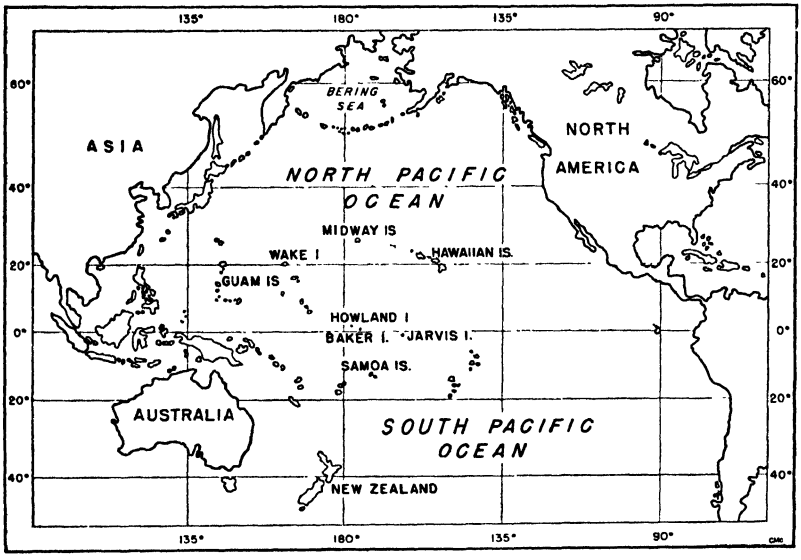


Fig. 133. Island possessions of the United States in the Pacific.

organization; the remaining islands are all under the direct supervision of the Navy Department.

ALASKA

Retarded development. The economic development of Alaska has been retarded by isolation, cold climate over much of the country, unfavorable distribution of topographic features, and neglect by our government, which owns almost the entire area, and which has not pursued the aggressive policy there that characterized the development of the frontier at home. Climate and topography both have hindered the development of transportation facilities. Although the Yukon River is navigable for 1,200 miles, its mouth is poorly located and it is frozen for two thirds of the

year. A government-owned railway, serving only a small but valuable part of the country, connects Seward and Fairbanks. High mountains extending at right angles to the channels of trade present a serious obstacle toward the development of other overland routes.

Natural divisions and features. Alaska may be divided into three natural regions: (1) the mountainous section fringing the Pacific, (2) the Yukon basin, and (3) the Arctic plain. The lat-

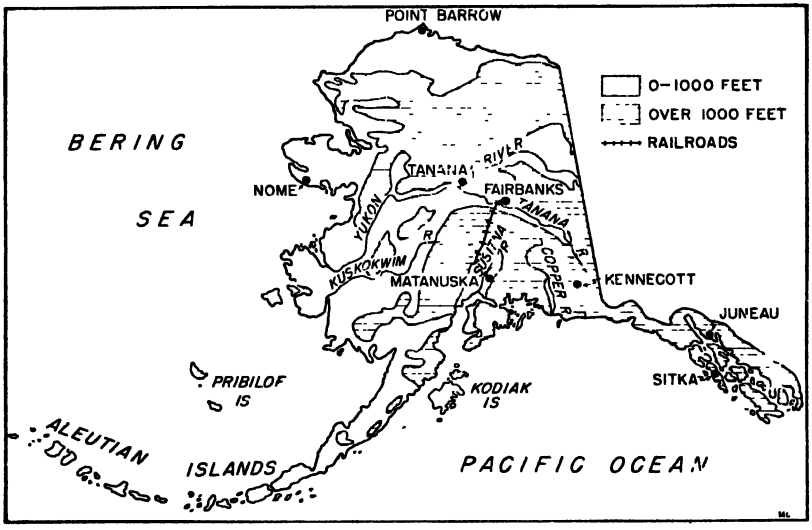


Fig. 134. Alaska

ter contains about 20 per cent of the total area, while the other two are roughly equal to each other in size.

Along the mainland, the mountainous section with its fringe of islands has many deep, fiorded valleys with glaciers, harbors, good fishing grounds, and water-power potentialities. The rainfall ranges from 60 to 120 inches a year, a condition favorable to the growth of heavy forests in some places. There are also supplies of various minerals. The region has mild temperatures, because of the westerly winds from the ocean and the Japanese Current. The damp and chilly summers, together with the mountains, limit the possibilities for agriculture. The Aleutian Islands, vol-

canic, treeless, and wrapped in fog, possess little but strategic value. Dutch Harbor on Unalaska Island is of great naval importance in our scheme of defense in the Pacific.

The Yukon Valley, about as large as France, is a low, rolling plateau with many wide valleys. There are considerable areas of small trees, reserves of several minerals, wide expanses of grazing lands, particularly for reindeer, and a considerable acreage of arable land. The light rainfall and the extreme temperatures are drawbacks to agriculture.

The Arctic plain, a little larger than the State of Oregon, is a great meadow with a continuously cool or cold climate and has few possibilities except for grazing reindeer, although reserves of coal and petroleum have been reported.

Forests. Both the Pacific and the Yukon sections have large acreages in trees too small to be of value, except for pulp manufacture. Some pulp is now being made in the Pacific section, where the species of trees are better for the purpose and where there is water power. In the region of Sitka, however, there are forests containing large trees of hemlock, spruce, and cedar, which may be used when our domestic supply of merchantable timber runs low. At the present rate of cutting, the reserves would supply Alaska for centuries. The timber is now used for local purposes and for making packing crates for the fishing industry.

Minerals. Except for placer mining, the exploitation of mineral resources has been at points close to the ocean, for large mining companies must have dependable transportation. The only important inland center has been around Fairbanks, which is connected by rail with the coast. Other important centers are the extreme southern end below Sitka, the vicinity of Juneau and Kennecott, and the hinterland of Seward. The important minerals are gold and copper. Recent monetary legislation in the United States helped to revive gold mining; copper mining increases with rising prices for copper. The United States Geological Survey has valued the remaining placer deposits of gold at $360,000,000.

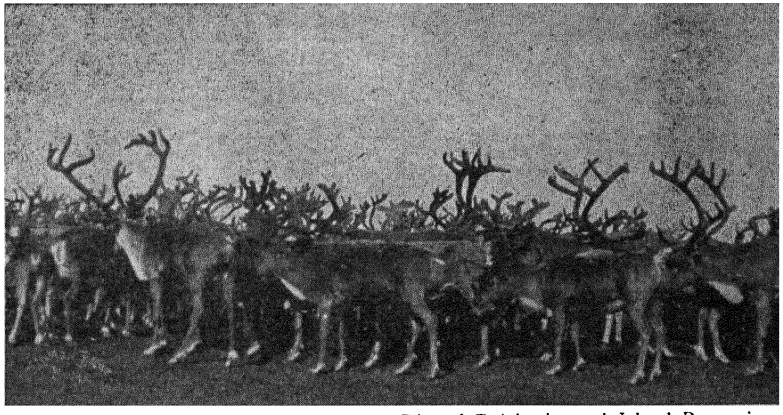
There are also large reserves of coal, chiefly in the Matanuska and Bering River Valleys, which ranges in quality from lignite to semibituminous. The government railway extends through the former valley with lateral lines serving the coal fields. Recent tests by the United States Navy have shown some Alaskan coal with a steaming value equal to that of Pocohontas coal. Coal is used locally for domestic fuel and for smelters, and some is exported to the Pacific Coast States. Petroleum of high quality occurs along Controller Bay.

Fisheries. Reference was made to the salmon industry in Chapter 7. This industry is most active along the broken coast of the Southeast, but extends as far as the Yukon. Other important fishery products are herring, halibut, whale, and clam. There is an investment of $70,000,000 in fishing, which is by far the leading industry of the country. Overfishing is taking its toll, however, and policing is difficult because of the great extent of the fishing grounds. The Japanese are now fishing much in this area beyond the three-mile limit.

Furs and trapping. About $2,000,000 worth of furs, chiefly seal, is shipped annually to the United States. Other furs are blue fox, muskrat, marten, and mink. The cold climate, extensive areas of forests, and protection provided in the large areas of government preserves provide a basis for a permanent trapping industry. There is also a domestic fur industry, with $7,000,000 invested in blue-fox ranches and smaller amounts in the growing of the marten and the mink. Where ranches are on islands, the animals are allowed to run loose.

Grazing. There are opportunities for the successful grazing of cattle and sheep on the lowlands around Cook Inlet and connecting bodies of water, where the mild, moist climate provides a good growth of grass, sufficient in some places for pasturage for 8 months or more. Greater opportunities exist, however, in the grazing of reindeer. About 30 acres are required for one animal, and it has been estimated that there are sufficient lands to supply pasture for 10 million. In Alaska there are now more than 700,-

000 reindeer, the progeny of about 1,200 animals imported from Russia and Siberia between the years 1892 and 1902. In addition, many animals have been slaughtered for food and for clothing, and sales have been made to Canada to start the industry there. The activities of the white man in the far north caused a decline in the supply of fish, and the introduction of firearms resulted in the rapid killing of wild animals; this depleted the supply of food so much that many of the natives faced starvation. The United States Government established reindeer grazing to provide the Eskimo with a more substantial base for subsistence. About 60



Dept. of the Interior, Div. of Territories and Island Possessions.

Fig. 135. Herd of reindeer, Alaska.

per cent of the animals are owned by the natives, and plans are now being formulated to control the entire industry for their benefit, for the entry of outside private interests has not been successful. Reindeer require about the same care as other range animals, and a few men with dogs can care for 1,500 or more animals. If domestic reindeer are not herded, they revert to their wild state.

There are a few packing plants in Alaska which slaughter reindeer and which recently have exported almost a million pounds of venison annually to the United States.

Agriculture. The potential agricultural districts of Alaska are the middle part of the Yukon Valley from above Fairbanks to

beyond Tanana, and the various river valleys and lowlands along the south coast, particularly the Matanuska and the Susitna Valleys, both of which are served by the government railway. There are now more than half a million acres in farms, and the area might be increased several times were there accessible markets for the products that can be grown. There are 2 million acres alone in the territory served by the railway. Other obstacles besides the lack of cheap transportation and markets confront agriculture. One is the thick coat of moss which must be removed before the land can be worked. Some of the unfavorable features of climate have already been mentioned. A further obstacle is the shortness of the growing season, though it is counteracted somewhat by the long hours of sunlight of the Arctic summer days. In the interior much of the land is permanently frozen underneath, and thaws for only a few feet in summer; but this condition is somewhat advantageous in that it helps offset the deficiency of rainfall.

For the most part only short-season crops, such as barley, oats, root crops, vegetables, and hay, can be grown. Most of these fit well into a dairy industry, products of which can bear rather expensive transportation to market. Small quantities of potatoes and other vegetables and hothouse products are now being profitably marketed.

The Matanuska Valley. The Matanuska Valley has recently become better known through the federal resettlement program which provides for the settlement there of drought-ridden farmers from our northern plains and farmers from cutover lands of the Great Lakes area where the quality of the land made subsistence farming impossible. This is a well-watered, fertile, wooded valley, 10 or 12 miles in length, hemmed in by mountains. It has a growing season of 130 days and, as was stated previously, has a railway through it. Each of the original 208 families received 40 acres of land and a federal loan of $3,000, to be repaid in 30 years. Modern homes and community enterprises have been provided. Not all of the original settlers remained, but there are several hundred other farm families on the waiting list to settle there.

Foreign commerce. The foreign commerce of Alaska normally ranges from 85 to 100 million dollars, the exports usually being double the imports; the trade is almost exclusively with the United States. Fish comprise 50 per cent, and canned salmon alone more than 40 per cent, of the total exports. Gold is now about half as important as fish. The leading imports are meat and other food products, petroleum products, and canning, mining, and electrical machinery.

HAWAII

Features. Hawaii, crossroads of the Pacific and a halfway station between the United States and the Orient, contains about 20 islands, 9 being inhabited, and is almost 80 per cent as large as Massachusetts. Honolulu, on an excellent harbor which has been heavily fortified by the United States, is a fueling station for ships and for airplanes, and is one of the best equipped seaports in the world.

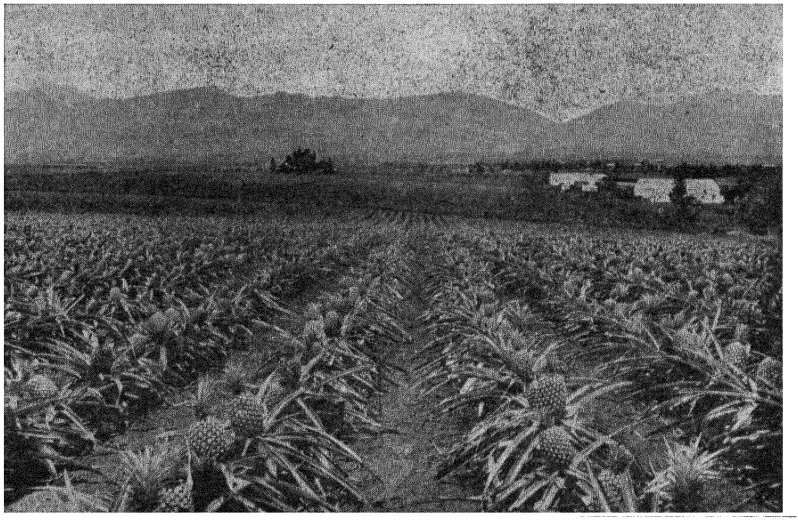
The Hawaiian Islands, mountains of volcanic origin, are located in the belt of northeast trade winds, and have, therefore, a wet and a dry side. The soil is fertile, being largely volcanic with a mixture of coral material around the edges of the islands.

People. About one third of the population of Hawaii is Japanese, but several other nationalities, particularly the Filipinos, Chinese, and Portuguese, are well represented. The native Hawaiian stock is facing extinction through intermarriage.

Cane sugar. Though rice is the leading food crop of Hawaii, sugar cane leads by far in commercial importance. The yield of cane sugar per acre is 3 or 4 times that of Louisiana, and the yield of sugar per ton of cane is about 50 per cent greater. The high yield results from fertile soil, use of fertilizer, irrigation, and the application of science to the problems of production. About half of the crop is grown under irrigation on the dry side of the islands. Some of the cane is started under a paper mulch, which promotes rapid growth by increasing the temperature and the moisture around the plants and by keeping down weeds. This method has

lessened the labor requirements at this stage more than half. The cost of the paper for mulch was reduced 50 per cent by making it from bagasse instead of importing it.

The sugar plantations are located near the coast on all the larger islands. The majority of the workers live on the plantations and receive a monthly wage plus a bonus which varies with the price of sugar. In addition they receive housing, fuel, schools, medical attention, and other services free of charge.



Dept. of the Interior, Div. of Territories and Island Possessions. Photo by Matson Line.
Fig. 136. Pineapple plantation, Island of Oahu.

Nearly all of the sugar is exported in the raw form, chiefly to refineries on our west coast.

Pineapples. Hawaii grows 80 per cent of the world's supply of commercial pineapples, for they thrive better and attain a more excellent flavor there than anywhere else. About 88,000 acres are planted to the crop, at elevations ranging from 500 to 7,000 feet, where rainfall varies from 60 inches or more to almost desert conditions. As with sugar, scientific methods of production are employed. Paper mulch materially reduces labor costs during the first year after planting by making cultivation unnecessary.

The first crop is ready to harvest about eighteen months after planting. Subsequent crops, until replanting is necessary, are obtained annually from shoots which grow from the old stalks. The crop is harvested in summer, when many Filipinos migrate to the islands. During other parts of the year some of them find employment on the sugar plantations. Pineapples are grown and canned by nine large companies and are grown under contract by many small producers. Most of the crop is canned by machinery invented especially for the purpose. The largest canneries are located in Honolulu, which receives most of the crops for canning.

The island of Oahu leads in production, but all the larger islands except Hawaii are important. A plentiful supply of suitable land together with other factors has caused frequent periods of overproduction.

Foreign commerce. The foreign commerce of Hawaii is about double that of Alaska and is carried on almost exclusively with the United States. The exports are usually about 35 per cent greater in value than the imports. Raw sugar comprises about 60 per cent of the exports, and canned pineapples 30 per cent. The leading imports are food products, textiles, petroleum products, machinery, automobiles, and fertilizer.

OTHER ISLANDS

Several islands have been owned by the United States for some time, but Kure, Howland, Jarvis, and Baker Islands, all valuable for air bases, were not claimed until 1936. Some of them had been uninhabited until that year, when our government laid claim to them by sending young Hawaiians to care for meteorological stations, which were established to aid air navigation. The other islands are also important to aviation. The only product of any commercial importance on any of these islands is the coconut; copra and coconut oil are exported in small quantities from a few of them.

Wake Island is on a direct route from Honolulu to Hong Kong.

Midway Island has a cable station, and Guam, which is important as a naval base, has a powerful government radio station. American Samoa, consisting of half a dozen islands, has the atoll harbor of Pago Pago, probably the most valuable harbor in the Pacific. It is a naval and fueling station.

Part Two

FOREIGN COUNTRIES

INTRODUCTION

IN the following studies of countries, the primary object is to develop an understanding of how the various countries fit into the industrial pattern of the world and to ascertain the degree of interdependence that exists among them. To attain this objective, we must emphasize what the nation has to work with, how it makes use of its natural wealth, and the trade it carries on with other nations.

Students of geography should not lose sight of the interdependence of nations, the reasons for which are discussed in more detail in the concluding chapter. Economic development naturally cannot be spread uniformly over the world because of the variants in cultural progress and in geographic conditions which cause industrial differences among nations. Because of favorable combinations of factors within limited areas, a few countries are able to dominate world affairs. Some countries may not make great industrial progress for some time; as a result, their people will have to depend on the more advanced countries for the products of modern civilization. In other countries, the leaders are not satisfied with their present dependent condition, and so they are trying in one way or another to obtain greater control over unexploited natural resources.

The high degree of interdependence existing among the highly industrialized countries, particularly the manufacturing countries of Europe, should be noted. Advanced in manufacturing, they specialize in products of superior quality. Obviously there is not much demand for such products on a frontier, their markets being rather among people of high standards of living, a condition prevalent in places which have a high degree of mechanization and in which the use of power resources has been highly developed.

Although frontiers provide only limited markets for complex manufactures, they can supply agricultural, mineral, and forest products to the older, more advanced countries whose domestic supplies of natural resources are depleted. Thus older, aggressive countries tend to compete for the resources of younger, less industrialized areas in various parts of the world. This competition may result in conflict, both political and economic, since only a few countries can succeed in gaining control of such resources.

On the whole, the highest standards of living are in those countries where complex manufacturing prevails, and only a few parts of the world are adapted ideally to such manufacturing. To maintain these high standards it is necessary that manufacturing continue and that the exchange of products continue among the manufacturing countries and between these countries on the one hand and those which supply raw materials on the other. Any interference with this exchange means that people will have less of certain products, will be compelled to pay more for them, or will be forced to go without them—in other words, the standard of living will have declined. The exchange of products among nations is essential to the greatest human welfare and to a smooth-running world.

24
CANADA

Canada and the United States. Canada, like the United States, is an American extension of northern Europe. Racially and economically, it is bound closely to the United States. Of the 11 million inhabitants, 52 per cent are British and 28 per cent French; 80 per cent are Canadian born. Canada ranks second only to the United Kingdom as an export market for our surplus products, and no country exceeds it as a source of imports to the United States. Again, only the United Kingdom is ahead of the United States as a market for Canadian exports, and the latter is by far the leading source of imports into Canada.

These relationships with us are the result of proximity and friendliness, the abundant natural resources and reciprocal needs of each country, and the relative industrial age of each. Since the natural resources of Canada are of a type that requires relatively little labor for exploitation, a large surplus is left for export, which in turn results in high per capita imports.

Natural regions. Canada may be divided into (1) the eastern highlands, (2) the central plain, and (3) the western mountains. The eastern highlands may be subdivided into (a) the Laurentian upland, (b) the Appalachian region (the Maritime Provinces and Newfoundland [1]), and (c) the St. Lawrence lowland. The distribution of territory and population among these five regions is roughly as is shown in the table on the following page.

[1] A section of the coast of Labrador belongs to Newfoundland. Although Newfoundland has a separate government from Canada, it will be discussed as a part of this region. In 1933, as a result of inability to meet financial obligations, the government was suspended and these obligations and general supervision were assumed by the United Kingdom until Newfoundland should be again able to meet its debts.

Region	Per Cent of Total Area	Per Cent of Total Population
Laurentian upland	63	7
Central plain	14	16
Western mountains	19	7
Appalachian region	3	10
St Lawrence lowland	1	60
Total	100	100

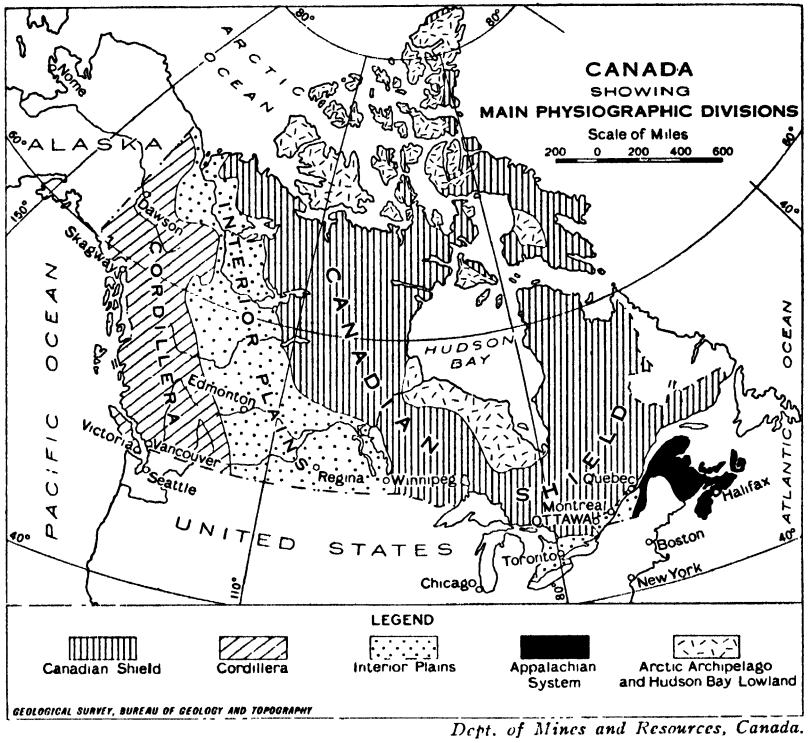
The *Laurentian upland,* with a bold front overlooking the St. Lawrence lowland, was formerly a region of high mountains with many igneous intrusions. It is heavily mineralized in some places, and it may become one of the great mining regions of the future. Its geological structure and glaciation have caused it to be almost barren of soil except in spots; but its plateau-like topography, together with evenly distributed precipitation, has created abundant resources of water power. Enough soil, however, has collected in depressions and in cracks in the rocks to permit trees to grow, and much of the region has coniferous forests. These three resources—minerals, water power, and forests—suggest the future of the region. The sections that have good agricultural soils are limited by climate and isolation. The clay belt to the south of James Bay is one such spot. It was formed by the collection of sediment in a lake along the front of the glacier that once was there. There are said to be other areas with good soil to the south and west of James Bay.

This upland has thrust a tongue of inhospitable land almost 1,000 miles in width between the central plain and the St. Lawrence lowland, the two leading producing areas of Canada. This territory increases the difficulty of obtaining cheap transportation to unite the two sections.

The *Appalachian region* is an extension of the Appalachian region of the United States. Although topography and climate have not favored agriculture except in places, there are large deposits of some of the baser minerals, abundant water power, and good forests. This region extends farther into the Atlantic than any other part of North America. This gives it significance as a

probable base for air traffic between North America and Europe, provides important commercial advantages for its seaports, and places it in the midst of the great fishing grounds of the North Atlantic.

The *St. Lawrence lowland* is "the heart of Canada." It consists of the St. Lawrence Valley, a former arm of the ocean, and



Dept. of Mines and Resources, Canada.

Fig. 137. Natural regions of Canada.

the lowland lake region of Ontario. The former is separated from the latter where the rocks of the Laurentian upland cross the river to form the Adirondacks. The importance of this region is found in its climate and soil, which permit considerable agriculture, but probably more in excellent transportation connections with other regions, location alongside the industrial part of the United States, and great resources of water power.

The *central plain* is the northerly extension of the Great Plains of the United States. Rainfall is light, but the region is not as arid as much of the plains in the United States because its cooler climate retards evaporation. Open to the Arctic, it permits the cold storms of winter to sweep down across the continent. The soil is fertile, and a combination of underlying material and climate results in the proper conditions for maintaining the fertility for a long time. The region is important for cereals and animal products. There are also enormous reserves of coal and considerable supplies of petroleum.

The *western mountain region* consists of parallel ranges of mountains with intervening valleys and plateaus; many of the summits are as high as 10,000 feet and some considerably higher. The moderating effects of the ocean are shut off from the region and from the plains to the east, and although there are a few relatively low passes, the mountains have been a barrier to transportation. The area has supplies of minerals—lead, zinc, silver, copper, coal—excellent forests, water power, grazing lands, specialized agricultural possibilities, and rich fisheries along the fiorded coast. Isolation, inaccessibility, the short growing season of the northern part, and light rainfall in many places have been retarding influences.

Forests. About one third of Canada is forested, 80 per cent of the forests being coniferous. About 25 per cent of the forested area has merchantable saw timber. The remainder has timber that is too small to be used for anything but pulp and paper, and some parts are so far from markets that it is doubtful if the trees ever will be used. A crop of pulp timber can be grown in about 30 years.

There are 3 forest regions: (1) British Columbia, (2) the Prairie Provinces, and (3) the east. British Columbia, where the forests are an extension of those of Washington and Oregon, possesses two thirds of the saw timber of the Dominion, mostly in the southwest. Douglas fir, spruce, cedar, and western hemlock are the

leading species. In the Prairie Provinces the forests are in the north, where they gradually merge into the belt of conifers which crosses Canada. Poplar, spruce, and jackpine are the principal species, and they are used mainly for fuel. The eastern forests are largely conifers, but in the southeast there are several species of hardwoods, birch and maple predominating. The leading softwoods are spruce, hemlock, and white and red pine. This is a great pulp and paper manufacturing area. Spruce provides two thirds of all the wood for pulp in Canada. Quebec makes about half of the paper and pulp of Canada, while British Columbia cuts 40 per cent of the lumber. Spruce is also the leading tree cut for lumber, supplying about a third of the total, but Douglas fir is only slightly behind. Snow and swift streams are a great aid in lumbering.

Ninety-two per cent of the forest lands of the country are Crown lands owned by the Provincial governments, and they are leased to private companies for exploitation. Thus far about 12 per cent have been leased, but this includes the areas with the best timber. Some companies have concessions as large as some of our smaller states. Both the Dominion and the Provincial governments encourage the forestry industry, because it is recognized that a large part of the country is fit for nothing but trees and that proper attention will assure a major resource of continued importance. The Dominion is also looking to the interests of its own people in the exploitation of the forests and does not permit outside interests to remove the resources without considering their importance to the people of Canada.

Minerals. Although Canada seems to be immensely wealthy in mineral reserves, the isolation of much of the country and the lack of transportation in the mineral districts have retarded their exploitation. There are large reserves of coal, asbestos, cobalt, and nickel, and probably of several other minerals. The leading mining districts are the Sudbury and the Porcupine districts of Ontario, important for nickel and copper, and gold respectively,

and the Kootenay district in southeastern British Columbia, which has lead, zinc, and copper. The total mineral production in 1936 was a little more than $360,000,000. Gold comprised 21 per cent of the total, coal about 13 per cent, and nickel and copper each about 11 per cent.

Canada has coal reserves about one third as great as those of the United States. Practically all are in western Alberta, but the northern part of Cape Breton Island has a reserve estimated at 10 billion tons. Production is small and stable, about 15 million tons annually, and is about equally divided between Alberta and Nova Scotia. British Columbia has deposits near Alberta and on Vancouver and some of the other islands. From there and from Nova Scotia it is profitable to export coal to near-by sections of the United States, which are located unfavorably with respect to domestic coal. On the other hand the St. Lawrence lowland is located most unfavorably with respect to Canadian deposits but is near the Pennsylvania coal fields, from which it obtains supplies of both bituminous and anthracite by boat and by rail.

It is thought that the Mackenzie River Valley has large reserves of petroleum, and there are deposits of oil sands of undetermined extent in the McMurray district of Alberta. The peninsula of Ontario and northwestern Alberta now produce some petroleum and natural gas.

There are scattered deposits of iron ore in British Columbia and in the Lakes district; one of the world's important reserves is on Belle Isle off the coast of Newfoundland. This ore, and coal from Cape Breton Island, can be united by cheap water transportation. This fact should make Sydney, which manufactures iron and steel as the result of a start made during the World War, an important future iron and steel center. Iron ore from Belle Isle is now exported largely to Europe.

Roughly, Canada produces 20 per cent of the world supply of copper, and 10 per cent of the gold, lead, silver, and zinc. Gold is produced largely in the Porcupine section of Ontario. Ontario, from the nickel-copper ores at Sudbury, produces 60 per cent of

the domestic output of copper. Quebec, chiefly at Noranda, produces about half as much, followed by British Columbia. The Flin Flon area on the border of Manitoba and Saskatchewan is a new copper district and also produces some zinc. Practically the entire production of lead and 80 per cent of the zinc are from British Columbia. Both are smelted at Trail. Silver is produced in the Cobalt and Kootenay districts.

Canada leads the world in the production of nickel and asbestos. About 90 per cent of the world's nickel is from the Sudbury district, where platinum is also obtained as a by-product. Canada ranks next to the U. S. S. R. in the production of platinum. Nickel-bearing ores are also located at Cobalt, second only to southern Africa as a producer of cobalt. Most of the world's asbestos is mined in a small area in Quebec along the Vermont border.

Recently a deposit of radium-bearing ore, pitchblende, was discovered near Great Bear Lake. The ore is transported by airplane and is refined at Port Hope. The important smelting centers of Canada are Sudbury, Trail, Anyox, Deloro, and Port Colborne. The lead refinery at Trail is said to be the largest and most efficient plant of its kind in the world. Much government encouragement and aid have been given recently to development of new mineral districts and to expansion of smelting facilities.

Water power. Abundant supplies of water power are available where power is needed most. The glaciation of a rugged region, the bold front of the Laurentian upland overlooking the St. Lawrence Valley, the great amount of forest cover, and well-distributed rainfall are the determining influences. Almost two thirds of the potential and 80 per cent of the developed water power are in Quebec and Ontario, largely along the valley of the St. Lawrence River, which is one of the greatest water-power sites in the world. The Saguenay and the St. Maurice Rivers are the sites of recent large developments. Manitoba has 18 per cent of the potential power and British Columbia 11 per cent. There is considerable potential power in the region of Winnipeg. This,

in view of the present importance of that city as a transportation and manufacturing center, may make it a great industrial center if the Prairie Provinces become densely populated. The total minimum power available in Canada is 18,000,000 horsepower; the maximum has been estimated as high as 43,000,000. About 8,000,000 horsepower is now developed, supplying two times the amount of energy obtained from the annual production of coal; 87 per cent is generated in large central stations.[2]



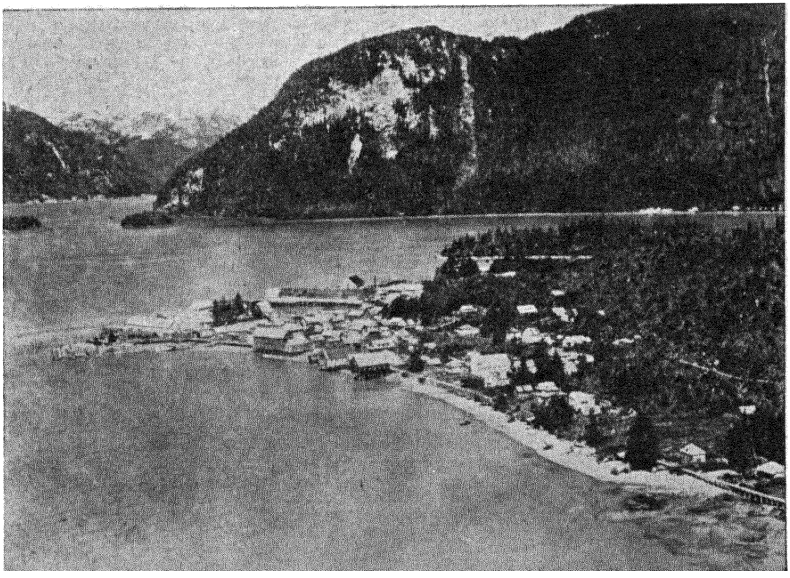
Dept. of Mines and Resources, Canada.

Fig. 138. Salmon fishing fleet starting out.

Fisheries. Canada has important fisheries on both the Atlantic and the Pacific. The inland fisheries are relatively more important than those of the United States; they have been overfished, with the usual results. Of the combined catch of Canada and Newfoundland, the latter contributes from 35 to 40 per cent. Dried cod comprise about 25 per cent of the total exports of Newfoundland; salmon, halibut, lobster, caplin, and leather seal are of minor importance.

[2] For a discussion of the water-power resources of Canada, see *The Canada Yearbook*, 1937, p. 389.

The Pacific fisheries are most important to Canada, supplying about 40 per cent of the total catch. Salmon leads in importance, but halibut and herring are also taken. On the Atlantic there are both shore and deep-water fisheries. Cod and lobster are the leading catch. Canada exports about 60 per cent of its catch, the fresh fish being sent to the United States, the preserved ones to Europe and the West Indies. In winter fish are caught in the



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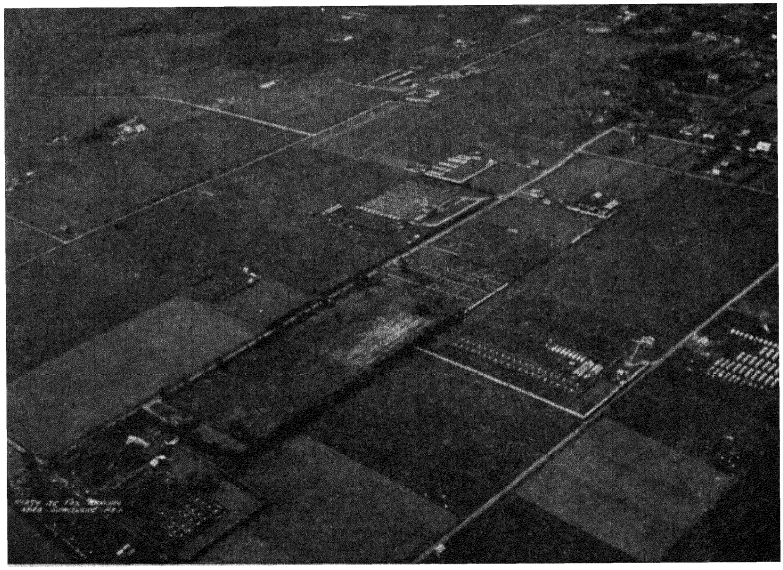
Fig. 139. A fish cannery on the fiorded coast of British Columbia.

northern lakes with nets placed under the ice, and taken by airplane to markets in our midwestern cities. The Dominion Government controls oyster beds covering 15,000 acres in Richmond Bay which soon may be of major importance.

Furs. Natural conditions in Canada favor the production of furs, and trapping and fur farming are both important. Between four and five million pelts are sold annually, 75 per cent being muskrat. Fur farms, in which there is an investment of $10,000,000, contribute one third of the total value of furs sold. There are 5,500 farms raising silver fox and 1,000 farms raising other

animals, Quebec having a third of the total. The production of blue fox is increasing in the Mackenzie Valley.

Winnipeg and Montreal are important fur markets, the former being the leading collecting center for furs in Canada. Edmonton is the chief supply depot at which trappers outfit themselves. The airplane is now used in bringing furs out of the far north, even from as far as the Arctic islands to the north of the mainland.



Dept. of the Interior, Canada. Photo by Royal Canadian Air Force.
Fig. 140. Fox ranches near Summerside, Prince Edward Island.

A load worth $50,000 is common, and some airplanes bring out loads worth as much as $125,000. The buying of furs is largely in the hands of the Hudson Bay Company, which has houses in all of the larger cities.

AGRICULTURE

Nature. Canada has two important agricultural sections: (1) the cool, moist southeast with its mixed crop and animal type of farming in which dairying predominates, and (2) the central

plain with its continental type of climate which favors cereal growing, but which has considerable grazing and some mixed farming.

According to Canadian authorities there may be as much as 361 million acres of land that are suited to agriculture, a quarter of which is yet in forest, and only a sixth now in field crops.

Canadian agriculture is faced with three problems: (1) the short growing season, which is counteracted to some extent by the long summer days, (2) the scarcity of labor, and (3) the dependence on foreign markets, a difficulty aggravated by the interior location of the producing areas.

The short growing season accounts for the importance of barley. Varieties of wheat which will withstand the cool climate have been developed and are still being improved to permit a further northward expansion. The growing of crops which are adapted to extensive methods and the increasing mechanization of agriculture have solved the labor problem. It is estimated that manpower was four times as effective in agriculture in 1932 as in 1922. In the plains farms are, therefore, necessarily large, the average in the leading wheat districts containing over 300 acres. Most of the farms are worked by the owners. The marketing problem has been met by keeping freight rates relatively low and particularly by the use of coöperative marketing.

Cereals. Wheat occupies about 40 per cent of the land in crops; oats are about two thirds and barley one third as important. There are small acreages of rye, flax, and corn, the latter being grown in the Ontario peninsula. Saskatchewan is the leading province in cereal production.

The wheat region is an extension of the spring-wheat region of the United States. A small amount of winter wheat is grown in the St. Lawrence Valley, where the temperatures are comparatively mild and where a heavy snowfall provides protection from the cold; and in southwestern Alberta, where the mountains and Chinook winds cause the winter to be milder and shorter than in

Saskatchewan. The Chinook winds are important in the climate of the entire western part of the plain. There is a potential wheat-growing area of 80 million acres, only one third of which is now in the crop. Drought and early frost are serious menaces, the annual production of all cereals often fluctuating widely because of them.

Oats, barley, rye, and corn provide feed locally for livestock, and in the plains these cereals are an important factor in lending diversity to farming in a region where there has been extreme dependence on wheat. Flax is grown for its seed.

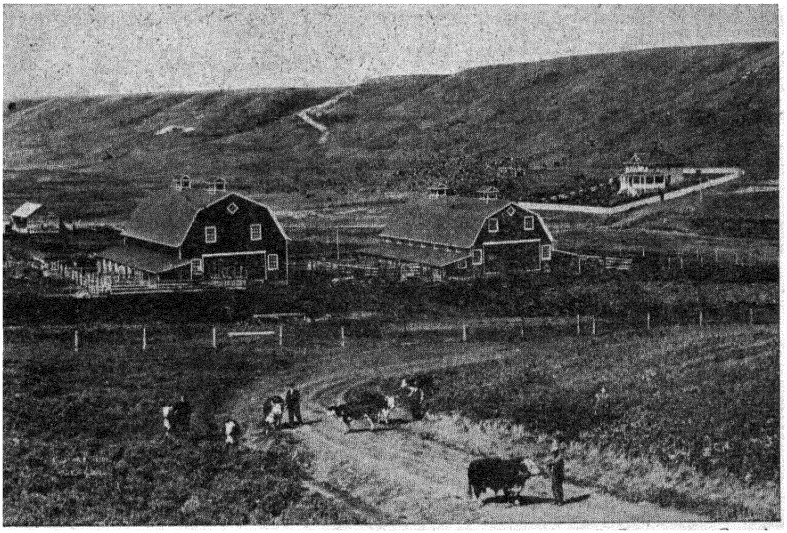
Foreign trade in wheat. Canada produces a little less than 10 per cent of the wheat of the world but for several years has led in exporting, contributing about 40 per cent of the world exports. Normally two thirds of the crop is exported. Before the World War, the United States and Russia were the most important exporters, and for a time after the War the United States led. Later, Canada took the lead because of (1) lower costs, which were a result of large, cheaply purchased areas of unused land and lower overhead expenses, (2) the higher protein content of the wheat, which resulted in a greater amount of bread per bushel, (3) better location with respect to water transportation and lower rail costs for equal distances, and (4) the fact that the United Kingdom, the leading wheat importing country, gives trade preference to Canada under the Empire tariff system.

Other crops. Hay and forage crops are grown on almost 20 per cent of the crop land. Two thirds of the acreage is in Ontario and Quebec where dairying and sheep growing are important. Alfalfa is grown under irrigation in southwestern Alberta.

There is an increasing acreage of bright-yellow tobacco in the Ontario peninsula. It provides leaf for the domestic market and also exports to Great Britain.

Fruits, especially apples, are important. There are three centers of production: the Annapolis Valley in Nova Scotia, the Ontario

peninsula, and British Columbia. The Annapolis Valley, which is protected from cold by mountains and bodies of water and which has the added advantage of nearness to the British Isles, is the leading apple section. In Ontario, where large local markets exist, and where the lakes delay opening of spring and reduce danger of early frosts in autumn, all varieties of middle-latitude tree fruits are grown. British Columbia has an apple industry similar to that of Washington, the Kootenay and the Okanogan



Dept. of Trade and Commerce, Canada.

Fig. 141. Cattle ranch in Alberta.

Valleys being the principal centers. Various middle-latitude fruits are grown along the coast. At the Imperial Apple Show in England in 1925 the Jonathan apple from British Columbia was judged to be the best eating apple grown in the British Empire; the Ontario Island Greening was pronounced the best cooking apple.[3] British Columbia is the leading province in fruit production, contributing 50 per cent more in value than Ontario, which is second.

[3] *Canada and the Twentieth Century*, published by the Royal Bank of Canada, Montreal, 1926, p. 25.

Animal industries. Southeastern Canada, with its cool, moist climate and rolling land, leads the prairie region in all animal industries except in the number of beef cattle and horses. Geographic conditions cause animal industries to predominate in the agriculture of the southeast, whereas, in the prairie region, though some parts are adapted only to grazing because of light rainfall, the increasing number is largely for the purpose of diversifying agriculture.

Cattle, 55 per cent of which are the beef type, comprise about half the total number of animals in the Dominion. The numbers of sheep and of swine are about equal. Ontario has 30 per cent of the domestic animals and ranks first in all except horses, and has 40 per cent of the poultry. Swine for bacon, which finds a ready market in Great Britain, are fattened on skim milk and barley or oats.

Natural conditions in the Southeast limit crops to root crops, hardy cereals, and hay and grass; such products can be utilized most profitably as feed for dairy cows. A small but growing domestic market and tariffs against the importation of butter and cheese into the United States have limited near-by markets. But by coöperative marketing and careful methods of production and inspection, the Canadians have been able to create a large market for cheese in Great Britain.

MANUFACTURING

Importance. Manufacturing is now the leading economic activity in Canada, the value added to products by manufacture being 30 per cent more than the value of the output of agriculture. Manufacture is largely concerned with processing the products of farm, mine, and forest (Fig. 142), and with supplying certain goods for the home market. Complex manufactures have been retarded by (1) the unfavorable location of domestic coal with respect to centers of population and industry, (2) the sparse population, which limits markets and results in high labor costs, and

(3) nearness to established manufacturing centers of the United States. The World War, protective tariffs, the Empire preferential tariff system, and favorable conditions of transportation have been encouraging influences. Canada now ranks second in the Empire in manufacturing, and sends small quantities of manufactured goods to various parts of the Empire. A recent tendency has been to supply textiles, leather, and rubber goods to export markets. A quarter of the manufacturing is done by American companies which for various reasons have located branches there. Some go to obtain cheap raw materials, others to circumvent high Canadian tariffs and to take advantage of Empire preference in

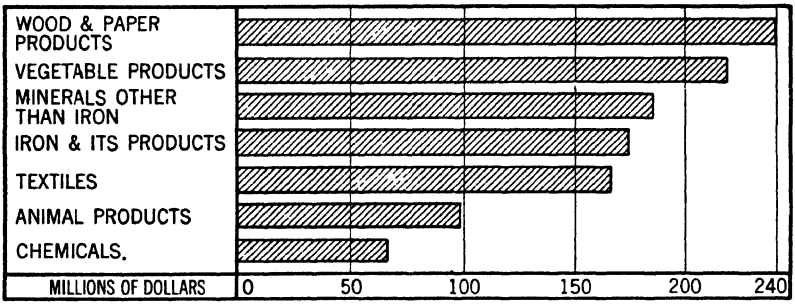
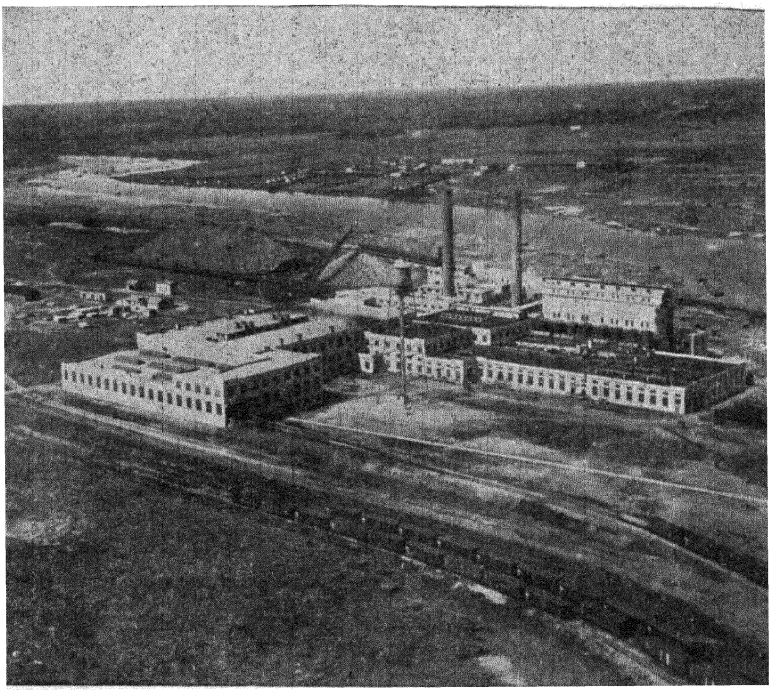


Fig. 142. Leading Canadian manufacturing industries in value added by manufacture, 1935.

shipping to different parts of the Empire; still others go there because Canadians prefer to buy products which are made at home.

Ontario produces about 50 per cent of Canadian manufactures, Quebec about 30 per cent. Ontario ranks high because of local supplies of several raw materials, excellent rail and water connections, cheap hydroelectric energy supplied by the Provincial government, and a local market and a central location for shipping to other parts of the country. Montreal contributes one third of the total manufactures, but it is only slightly ahead of Toronto, which is located well for marketing and for obtaining Pittsburgh coal and Lake Superior iron ore cheaply. Although many dif-

ferent products are made there, Toronto is relatively more important for steel and other heavy industries than is Montreal. Hamilton and several small cities along the Lakes are largely engaged in making steel and smelting other metals. Local raw materials and falls in the Ottawa River and the navigability of its lower course make Ottawa an important center for lumber and cement.



Dept. of the Interior, Canada. Photo by Royal Canadian Air Force.
Fig. 143. Paper mill, Kapuskaking, Ontario.

The city of Quebec, an early center of population, manufactures textiles and is a growing pulp and paper center; at the junction of the Saguenay River with Lake St. John are rising electrochemical and electrometallurgical industries. The larger cities of the Prairie Provinces have meat packing and flour milling, and Regina has petroleum refineries; Vancouver, on the Pacific, mills lumber and makes steel, ships, and other products.

The pulp and paper industry is of such importance in Canada that the following more detailed discussion seems merited.

Pulp and paper. The manufacture of pulp and paper is important because of (1) abundant supplies of good timber, (2) abundant water power, and (3) nearness to the markets of the United States, the greatest paper consuming country in the world. From 80 to 85 per cent of the paper production is newsprint for

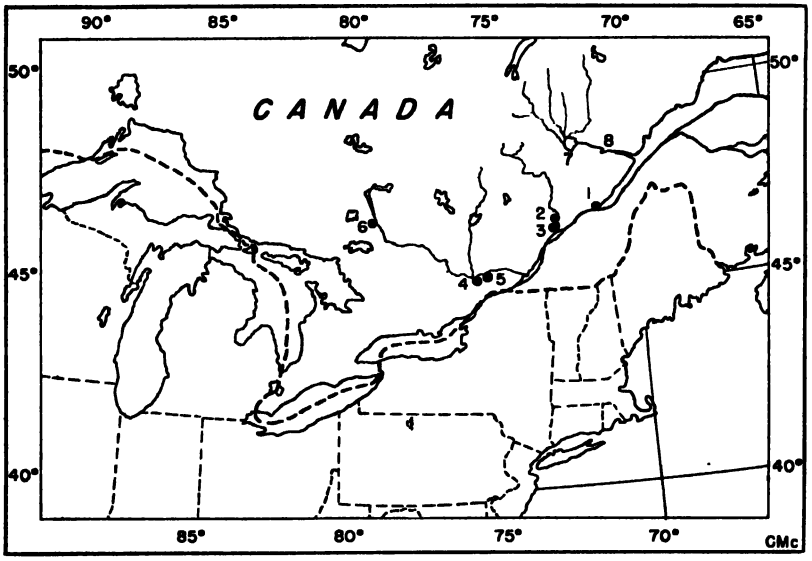


Fig. 144. Pulp and paper manufacturing centers of Canada. (1) Quebec, (2) Shawenegan Falls, (3) Three Rivers, (4) Ottawa, (5) Gatineau, (6) Timiskaming, (7) Lake St. John, (8) Saguenay River.

the United States. Wood pulp finds little market here, but is sold in Canada and exported to other countries. Since the manufacture of pulp and paper requires large amounts of cheap power, the expansion of the power industry has been influenced by this industry. The developed power then attracts other manufacturing industries. Canada is thus using two important natural resources in the most efficient manner. Neither the electricity nor the timber can be transported for long distances profitably, but the water power is used to put the timber into a compact form in which it can stand high transportation charges. In addition sur-

plus power can be developed to attract other industries; as a result the country has employment for more labor and the added wealth represented by the different industries.

The pulp and paper industry is located principally along the northern edge of the St. Lawrence Valley, where it meets the Laurentian upland, and in the region of Lake St. John. The largest paper mill in the world is at Three Rivers, and there is one nearly as large at Gatineau. The mill at Timiskaming in Quebec produces about half the world's supply of cellulose for rayon. Another center is at Shawenegan Falls on the St. Maurice River. About 25 per cent of the investment by interests in the United States in Canada is in paper mills.

Newfoundland also has an important pulp and paper industry, the industry normally supplying about half of the exports. Grand Falls, where a large British publishing company operates a mill, is the leading center, but there are also mills at Bishop Falls, Corner Brook, and Lomond.

FOREIGN COMMERCE

As was stated previously, the prosperity of the Dominion of Canada depends largely on foreign trade. The exports and imports are fairly evenly balanced, the former usually being somewhat the greater, but occasionally the imports are larger. The per capita foreign trade has recently been about $110, which average is among the highest in the world. Roughly, 80 per cent of the total foreign trade is with the United Kingdom and the United States. About two thirds as much is exported to us as to the United Kingdom, while only one third as much of the imports come from the United Kingdom as from this country. We produce many of the same products that Canada exports; and proximity, similar types of industries, and analogous tastes result in more imports from the United States than from the United Kingdom.

A few of the points of entry handle the bulk of the foreign trade. Montreal, at the head of deep ocean navigation and at the

junction of four natural routes, handles about 25 per cent of the total and is the world's leading wheat exporting city. It has 9 miles of deep harbor capable of accommodating 100 large ocean steamers at one time, about 15 million bushels of storage capacity for grain, and a large cold storage warehouse. Quebec, with a

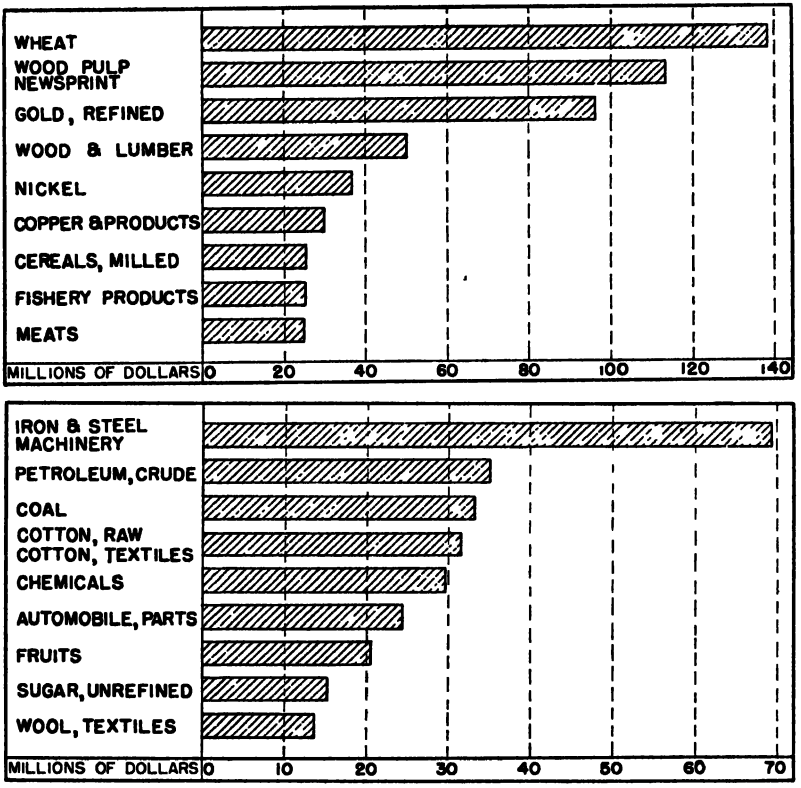


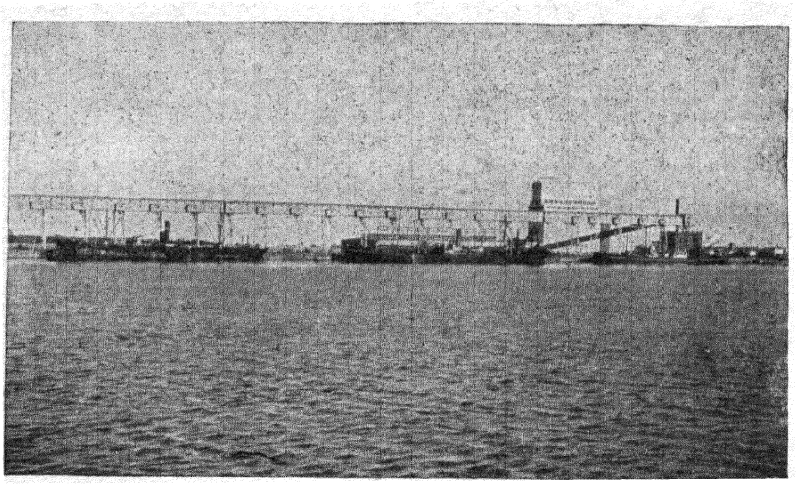
Fig. 145. Principal items in the foreign commerce of Canada in 1935, exports above, imports below.

recently improved deep harbor and a new bridge across the St. Lawrence, is a growing port, important for passenger travel. It can accommodate larger ships than Montreal, and many passengers like to travel overland from Quebec to save the extra time that would be required to go on to Montreal by boat. Both ports are closed by ice for about one third of the year, and in winter and

until early summer the danger from ice causes insurance rates on ocean shipping from the ports to be much higher than from a port such as New York.

Halifax and St. John have a large export traffic when the St. Lawrence is frozen. Halifax handles about six per cent of Canada's foreign trade, St. John a little less.

Vancouver and Toronto follow Montreal, each with about ten



Natl. Development Bu., Dept. of the Interior, Canada.

Fig. 146. Grain elevator and docks at Fort Churchill, Manitoba.

per cent of the total foreign commerce. Vancouver owes its rise to the Panama Canal, the Oriental markets, and the westward expansion of wheat growing. Much of the wheat district is closer to it than to Port Arthur and Ft. William on upper Lake Superior. Vancouver is the leading port for shipping Canadian-grown wheat. Montreal normally exports much wheat that is grown in the United States. Toronto is important because it is a leading manufacturing city and because of its position with respect to the United States. The Canadian National Railways tried to develop Prince Rupert as a competitor of Vancouver, but the adverse factors of isolation and location on a fiorded coast have been too great. Ft. Churchill, built on Hudson Bay for exporting wheat

from the Peace River region, now handles about one per cent of the wheat exports of Canada. Some manufactured goods are imported through it. The open season for operating ships on Hudson Bay is from July 15 to October 1. It is thought that specially built vessels could navigate the route from June 15 to November 1. During the open season, however, Hudson Strait is frequently filled with floating ice which is often accompanied by heavy fog.

25

THE BRITISH ISLES

Reasons for Britain's rise. Several factors are responsible for the high position of Great Britain among the world powers. The mild climate, productive soil, and type of people are of primary importance. Insularity has provided a security that countries on the Continent lack. This permits industry to develop unmolested. The feudal system was abolished there before it was on the Continent, with the resulting incentive which goes with freedom of labor and enterprise. The accessibility of all parts of the islands to the ocean, the central location with respect to other countries and continents, and nearness to the most highly developed section of Europe have given Britain a commercial advantage. Probably most important have been the large supplies of coal and iron ore. Although there are still large reserves of low-grade iron ore, much ore must now be imported. But large reserves of coal still exist, which, with the momentum and experience gained by an early start, help to maintain Great Britain in the front rank as a manufacturing country. Her enterprise in training men to the sea and in building a great navy and a merchant marine, in exploring and colonizing many parts of the world and in lending capital throughout the world, have also been highly important.

Area and population. The British Isles contain about 121,000 square miles of territory and 50 million people. They are twice the size of our New England States and have six times as many people. England contains 75 per cent of the population, Scotland 10 per cent, and the Irish Free State 6 per cent. The density of population is about 1,250 per square mile in the Channel Islands,

745 in England, 300 in Wales, 230 in Northern Ireland, 223 in the Isle of Man, 160 in Scotland, and 114 in the Irish Free State.

Geographic features. While there are no great altitudes in the British Isles, there is sufficient variety of topography to cause differences in climate, soil, and other natural resources. Furthermore, the area is so small and the differences in topography so distributed that the various natural resources are located favorably with respect to each other.

The long and irregular coast line places all points close to the sea, and the shallow surrounding seas and narrow inlets cause high, swift tides which provide deep water for harbors and also help to keep them free of silt and sand.

Western and northern Great Britain are largely a highland of old crystalline rocks, standing at a right angle to the prevailing westerlies. This region, therefore, has a poorer soil and heavier rainfall than the remainder of the island. Consequently, though ill adapted to crop production, it is favorable for grazing. Water power in these highlands provided a source of energy in the early days of manufacturing; now the water is important for supplies for manufacturing processes and for municipal purposes.

The Pennines, the backbone of England, are made up of arched or folded sedimentaries, with eroded layers, having large areas of bog along the crest. They have further been faulted with the bold face to the west, and the gentle slope has been covered with younger sedimentary deposits which make up the plain to the east. There are coal measures at each of the four corners, where they have been preserved by the sedimentary formations. These mountains, though a barrier to transportation, contain the important Tyne and Aire gaps.

The greater part of England may be classed as rolling or hilly plain, composed of dipping layers of sedimentaries, the outcrops facing northwestward in parallel belts of ridges with intervening lowlands. Much of the outcrops is porous limestone or chalk and therefore, being rugged, makes good sheep-grazing land. In the intervening vales are more fertile soils on which crops are

grown and cattle are grazed. This region is the leading agricultural section of the British Isles.

The central lowland of Scotland, in which 90 per cent of the people of that country live, has a rolling surface and contains many pockets and basins in which minerals, especially coal, have been protected from erosion. The several types of mixed soil make the area fertile and adapted to various crops.

Ireland is largely a well-watered but poorly drained basin or plain with a surrounding rim, mountainous in some places. About 12 per cent of the island consists of peat bogs, the peat being used as fuel. Limestone formations covered with glacial clay floor the plain. The glacial deposits are thicker in the eastern part and, along with less rain and cloud, make that area the better agricultural section.

Climate. Relief and cyclonic control give the British Isles some variety in climate, even though the area is small and surrounded and penetrated by water; the North Atlantic Drift and general effect of the westerlies tend to offset differences due to the variety in latitude. In winter the temperature declines from west to east, the January isotherm of 40° extending almost due north and south along the entire west coast of the island of Great Britain; in summer the decline is from south to north. This is a good illustration of the relative effects of the ocean in winter as contrasted with the summer. There is much cloudy weather and fog, the latter being especially severe in southeastern Great Britain in winter. The southeastern part of England has the greatest extremes in temperature of any part of the islands.

Most of Ireland, Scotland, Wales, and northwestern England have between 30 and 60 inches of rainfall annually, and the highest parts have more than 60 inches. The main agricultural part of England has an average of about 25 inches. It is well distributed, however, and this in conjunction with the cool climate, which retards evaporation, makes the rainfall sufficient for agriculture.

Fisheries. Among the most famous fishing banks in the world are the Dogger Banks which form a submerged plateau off the east coast of England, where the water varies from 60 to 120 feet in depth. The location of these banks and the abundance of fish have been important factors in the rise of the maritime nations of Europe. A training ground for seamen was provided as well as a product for food and for exchange with other regions. The ocean currents are important in maintaining the supply of food for the fish.

The fishery industry of the British Isles employs a little more than 100,000 people and has an annual product of about $80,000,000. Fish are imported, but there is a net export. Two of the leading fishing ports are Grimsby and Aberdeen.

Minerals. Great Britain has deposits of several minerals, but most of the production now is of coal. Building stone and other construction materials comprise the greater part of the remainder. More than half of the pig iron used in the iron and steel industry is from ores imported largely from Spain, Algeria, and Sweden. As was stated previously, Great Britain's still large supply of iron ore is of low grade, and therefore high-grade ore can be imported to economic advantage. The principal domestic source of ore is in the Cleveland Hills, with small supplies near Barrow and at other points. In addition to the coal fields occurring at each corner of the Pennines, there are several other smaller deposits in England, three fields in the central lowland of Scotland, and one in South Wales. Ireland has a few unimportant deposits. The Welsh field and the one on the southeast of the Pennines, which is really several disconnected fields, are the leading ones; they have about equal areas and reserves.

The South Wales field is the newest and, being on water and with large reserves, provides most of the export coal. It covers an area of about 1,000 square miles, extending under the sea, and contains several beds of coal of high quality. Rivers which are deep enough to navigate have exposed seams in several places,

and in a few cases the coal is run directly from the mine through chutes into the ships; and the rail haul, where necessary, is never long. The eastern and central parts of the field produce steam coal, and the western part anthracite. About 80 per cent is bituminous coal, and 20 per cent anthracite. In the east there are 12

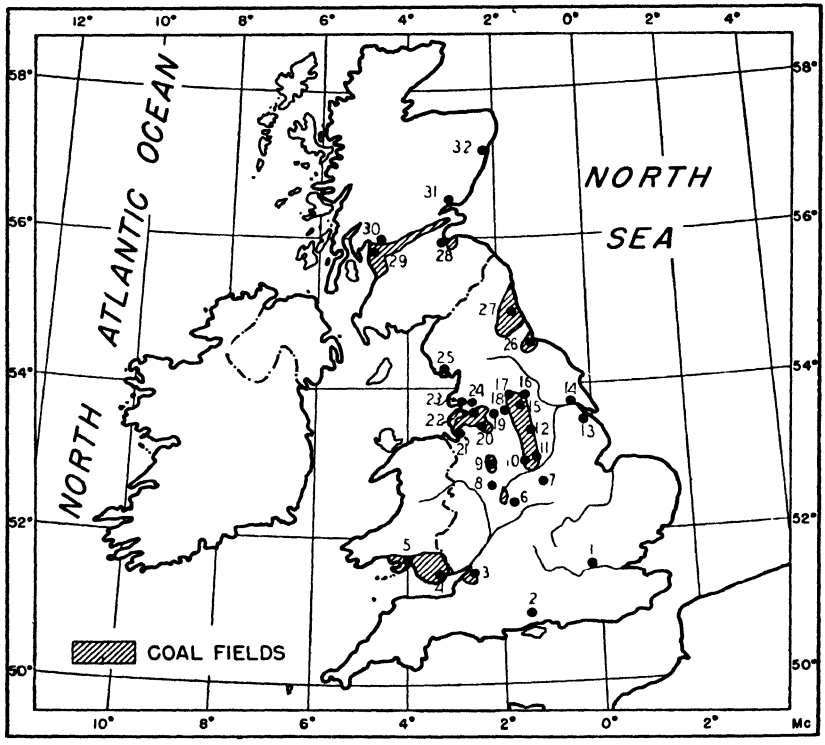


Fig. 147. The British Isles, showing the location of the leading cities and principal coal fields of Great Britain. Cities: (1) London, (2) Southampton, (3) Bristol, (4) Cardiff, (5) Swansea, (6) Birmingham, (7) Leicester, (8) Stafford, (9) Stokes, (10) Derby, (11) Nottingham, (12) Sheffield, (13) Grimsby, (14) Hull, (15) Batley, (16) Leeds, (17) Bradford, (18) Dewsbury, (19) Oldham, (20) Manchester, (21) Liverpool, (22) Bolton, (23) Preston, (24) Blackburn, (25) Barrow, (26) Middlesborough, (27) Newcastle, (28) Edinburgh, (29) Paisley, (30) Glasgow, (31) Dundee, (32) Aberdeen.

seams with a combined thickness of 40 feet, in the west 40 seams with a combined thickness of 120 feet. The anthracite is used for domestic purposes and for fuel in the malting, baking, and cement industries. The South Wales field is a great center for smelting metals.

On the southwest of the Pennines are several more or less continuous fields. First is the Lancashire field which produces chiefly gas coal. The formations also extend into Cheshire and there provide fuel for chemical and glass industries. To the south, Staffordshire has two coal fields, one supporting a pottery industry, the coal being overlaid with clay formations, while the other, with Birmingham as the center, is important for iron and steel products, iron ore being interbedded with the coal formations. There is also a small field in northeastern Wales. The Cheshire plain is thus almost ringed about by coal.

The coal of the York-Nottingham-Derby field, the leading producer, is for the most part used within England; but there is a growing export trade with the Baltic countries, through Hull. The quality is good; the coal to the north of Sheffield is a coking coal, that to the south a gas coal.

The Northumberland-Durham field, where the measures extend under the sea, provides fuel for the steel and chemical industries of the area, and for London, and export coal for the Baltic countries.

The Cumberland field in the northwest, which also extends under the sea, supplies fuel for a local steel industry and export coal for Ireland.

Coal measures are almost continuous in the lowland of Scotland, but mining is done chiefly in the Clyde Valley near Glasgow, around the Firth of Forth, where the largest reserves occur, and in Ayrshire. Iron and steel and textile industries are found throughout this lowland. There are also important deposits of oil shale near Edinburgh.

Agriculture. The British Isles are made up of 25 per cent arable land, 34 per cent permanent pasture, 20 per cent mountain and heath pasture, 4 per cent forest, and the remainder waste. The forests were nearly exhausted for charcoal for smelting iron ore before coal was used for that purpose; those remaining serve largely as pleasure grounds for the wealthy.

British agriculture is characterized by the preponderance of animal industries, which normally account for 60 per cent of the

agricultural production, by high yields and intensive methods in crop production, and by the relative unimportance of staple crops, which account for only 10 or 15 per cent of the total crop value. The more important crops are those which require intensive methods or which are perishable or bulky and must be grown near areas of consumption. Animal products are of major importance because the cool, moist climate and rugged land adapt the country to grass and because staple crops can more easily be shipped for long distances than can fresh meats and milk.

Great Britain's former free-trade policy, which was a result of her dependence on foreign markets; her advantages in foreign trade; and the strong navy, which has made possible reliance on foreign sources for foodstuffs—have all been of much influence in determining the nature of agriculture. Recently, with the growth of economic nationalism throughout the world and much unemployment in Great Britain, attention has been turned to a rehabilitation of British agriculture. Protective tariffs, import quotas, subsidies, and coöperative methods of marketing are all being employed for the purpose. The difficulties encountered in maintaining food supplies during the World War have also had the effect of encouraging more domestic production of various products.

Crops. Oats, grown on 20 per cent of the arable land, are the leading crop. Production, though widespread, tends to concentrate in the eastern part of the islands. In Northern Ireland oats occupy 30 per cent of the crop land; in Scotland they are grown on 75 per cent of the land devoted to cereals. Wheat and barley are grown in drier locations than oats, and each occupies a little less than half as much acreage. Wheat is grown on stiff clay soils, largely in the area between the mouth of the Thames and the Wash.

The crop is now subsidized to the extent of 50 per cent of the market price. Domestic wheat supplies one third of the total demand. Barley is grown chiefly in the wheat districts but far-

ther north as well, because it requires less sun than wheat and will grow on poorer soil.

Root crops, relatively more important in Ireland, occupy 13 per cent of the crop land. Potatoes lead, but Ireland has half as much acreage in turnips as in potatoes. Swedes and mangels are grown for forage. Sugar beets are a new crop, occupying about 400,000 acres in the wheat districts. Like wheat, they are heavily subsidized. The difficulty of obtaining sugar during the World War helps to explain the encouragement given to the crop.

Vegetable growing is important around all of the manufacturing centers, and the Channel Islands and the Cornwall Peninsula have winter-vegetable and flower industries. Fruit growing is widespread; apples, around the inner end of the Bay of Bristol and in Kent and Devon, comprise two thirds of the tree fruits. The eastern part of the lowland of Scotland grows apples and bush fruits, the cool, moist, cloudy weather favoring the latter. Hops for brewing are an important crop in Kent.

Animal industries. Sheep comprise nearly half of all of the animals of the British Isles. Cattle—an equal number of beef and of dairy—account for 35 per cent, and swine for 12 per cent. Dairy products constitute about one fourth of the value of the total agricultural production. There has been a material expansion of this industry during the past 15 years, owing in part to a campaign to encourage a greater consumption of milk. Fresh milk is the leading commodity, although cheese is also important. Although widespread, dairying is concentrated in the Cheshire plain and in northeastern and southwestern Ireland. Farming and stock raising are relatively more important in southern Ireland than in any other part of the British Isles. The mild climate and plentiful supply of moisture cause abundant vegetation. As a result Cork is the leading exporter of farm products in these islands, the exports, however, being sent to Great Britain. The leading export of the Irish Free State is live cattle to the English market.

Sheep are grown throughout the islands, but the greatest concentration is around the Wash and the Humber, and in Kent, Wales, and southern Scotland. A dual-purpose animal is grown, and different breeds have been developed to meet the various geographic conditions. Sheep are relatively less important in Ireland than in Great Britain because of poorly drained soil which causes foot and other diseases. Britain is moist for sheep, but the porosity of the soil in several places is a counteracting influence. Since cattle need better pastures than sheep, dairying is carried on more in the lowlands and valleys, which have better pasture and are more accessible to markets than the highlands.

Swine are raised widely, many being fattened on potatoes and skim milk. Ireland produces an excellent quality of bacon and ham, which finds a ready market in England. Poultry are kept everywhere, and are especially important in Ireland. That island probably has more animals per unit of area than any other country.

Manufactures. Manufactured goods normally comprise 85 to 90 per cent of the value of all production in the British Isles. Outstanding features of British manufactures are their concentration near the coal fields, particularly those which flank the Pennines; their high quality, which results from the skill and experience of the British workers and from the inability of the country to compete with newer manufacturing centers in coarse, cheap products; and the specialization which is characteristic of different districts and of different towns within each district.

Textiles. The textile industry usually contributes about 25 per cent of the value of all manufactures; cottons make up about half of the total and woolens about one fourth. Lancashire, in a section with the moist climate necessary for the manufacture of cotton before artificial humidifiers were invented, is still the center of cotton manufacturing. It is also on the side of the island next to America, the source of most of the raw cotton. Manchester, the leading textile city, is largely a commercial and storage center for the district. It is connected with the sea by a canal which ac-

commodates vessels of 15,000 tons, but as a seaport it has never been able to equal Liverpool, which imports materials for the other industries of its hinterland as well as for the cotton industry.

There is much specialization among the textile cities. The damp climate is not as necessary to the weaving as it is to the spinning of cotton. Consequently, the weaving cities, such as Preston and Blackburn, tend to be in places that are more sheltered from the westerly winds than the spinning centers, such as Oldham and Bolton, for example. Oldham has one third of the cotton spindles of England.

Eighty per cent of the woolen workers of Great Britain are in West Riding. Leeds is the leading center of woolen manufacture and of the manufacture of woolen garments. The industry grew in this region first because of water power and later because of coal. Since this part of England, because of its dry climate, has always been an important sheep-grazing district, the local supply of wool was also important. There is much specialization as to the type of fabrics. Bradford is the worsted center; Batley and Dewsbury manufacture shoddy. Leicester is the principal woolen hosiery center. Sixty per cent of the woolens are used domestically.

To the south of the woolen district, Nottingham is a cotton center, specializing in lace and hosiery; Derby is the center for the more recent rayon industry. A few places, notably Bradford and Macclesfield, manufacture silk, but this industry has never become important in England.

Textiles rank next to iron and steel in the lowland of Scotland. Alloa, Glasgow, and Paisley are woolen centers, and the last two are also important for cotton goods. Paisley is the leading city and specializes in cotton and linen thread. Since the heavy industries of this area employ large numbers of men, a supply of women labor is available for the textile mills. In the east, Dundee and the county of Fife are centers for linen, hemp, and jute manufactures. The woolen industry of the Tweed Valley in the southern uplands is in one of the oldest and most important

sheep-grazing areas; it began there because of resources of water power.

Belfast is the leading manufacturing city of Ireland and, in addition to shipbuilding, manufactures linen of a high quality from domestic and imported flax. The work is done largely by women.

Iron and steel. The manufacture of iron and steel and related products and of other metals is found in all of the coal fields. Iron and steel comprise 10 per cent of the total manufactures of the nation. The center of metal manufactures was originally around the southern part of the Pennines, at Birmingham, but since much of the iron ore is now imported, the industry has moved more to the coal fields along the coast, where the bulkier, cruder products are made, leaving or forcing the older centers to specialize on the production of finer or more valuable ones. Thus Sheffield and Birmingham and other cities in the same localities are important in the engineering trades, in the manufacture of automobiles, and in the making of hardware, cutlery, and other high-grade metal products. A feature of the iron and steel industry is the presence of engineering industries in most centers associated with either the shipbuilding or the railway industry.

Birmingham became important as an iron and steel center because of the local supplies of coal, iron ore, and limestone. Now it is the principal manufacturer of firearms, munitions, scientific instruments, engines, and automobiles. More and more Birmingham, at a meeting of routes, is becoming the commercial center of the area. This seems to be a natural tendency, since any industry expands outward from its original location. The skill and experience necessary in financing and selling, and the fact that a few people can look after these matters for a large area, tend to keep this work where it first developed. Financing and selling are also matters that seem to require centralization.

Sheffield became important in the manufacture of iron and steel because the carbonate iron ore formerly mined near there was of particular advantage in making steel of fine, hard, and keen

cutting edge and also because the water was especially good for tempering steel. It has maintained its lead because of the application of science to the industry and the maintenance of up-to-date factories. Like Birmingham it makes all kinds of steel products, but it is especially noted for its cutlery, light steel products, and tools. It is said to be without a peer in the manufacture of such products.

The South Wales coal field is the leading center of metal smelting in the British Isles. Iron ore is smelted at Swansea, Cardiff, and other points; copper, lead, zinc, and tin at Swansea and Llanelly. Swansea smelts practically all of the world production of tin and is the world leader in the manufacture of tin plate. Copper and tin were formerly obtained in the Cornwall Peninsula, but more paying deposits in other parts of the world have driven this area out of production. The iron industry also had its origin in local supplies of ore. Other advantages of this district are its supplies of limestone and its good harbors.

The cities along the lower Tees and lower Tyne Rivers comprise another important iron and steel district. Iron ore comes largely by water from the Cleveland Hills and is smelted for the most part at Middlesborough. Half of the British ships are made in this area. In the northwest, Barrow makes ships and armaments from both local and imported ores.

Glasgow is one of the greatest iron and steel centers in the British Isles. The River Clyde, on which the city is located, has been improved until it is really a canal with miles of deep water; because of this, it has become the greatest shipbuilding center in the world. One third of the British tonnage and ships for many other countries are built here. Glasgow is also the leading manufacturer of locomotives outside the United States. Coal, some local iron ore, and cheap skilled labor are all at hand. One half of the people of Scotland live in the Clyde Valley. Falkirk is one of the oldest steel centers in Scotland and now manufactures a great variety of products.

Belfast, with imported iron and coal, has an important shipbuilding industry and is especially noted in the construction of large passenger vessels. Cheap land and cheap labor are its main advantages.

Chemicals. The value of chemicals is about equal to that of iron and steel. The Lancashire, Yorkshire, and Northumberland coal areas are the centers of the industry. In the Cheshire plain, deposits of salt, coal, and limestone provide the basis for the industry. Alkali, soap, soda, sulphuric acid, heavy chemicals, and bleaching materials are made. The relation of several of these to the cotton textile industry should be noted. This region also manufactures glass. Birkenhead is important for soap manufacturing. The Newcastle district has the same combination of raw materials for chemical manufacture that Lancashire has, and Newcastle and Middlesborough both have chemical industries. In the Yorkshire coal field, sulphuric acid and coal tar products are the leading chemicals, for the coal mined there is nearly all treated for its by-products. The Birmingham district and the western part of the Scottish lowland also have chemical industries.

Other manufactures. The pottery industry is another which is centered in the Liverpool hinterland. Local clay is used for the coarser products, but for the more valuable ones kaolin is brought from the Cornwall Peninsula by the Weaver Canal. Pottery is also made on the Ayrshire coal field in Scotland.

The manufacture of boots and shoes is important at Stafford and at Leicester. Both places have long been the centers of important grazing industries. Leeds is another center of leather manufacture.

The processing and manufacture of foods from both domestic and imported raw materials ranks second among the manufacturing industries, amounting to about 20 per cent of the total output. Flour milling, sugar refining, the curing of meat, the preparation of dairy products, and the manufacture of liquors are all important. The latter industry is widespread, but is especially important in Ireland, Dublin being the leading center. Liquors are

second among the exports of the Irish Free State. Edinburgh is another important center for brewing and distilling. Since 1920 Hull has grown rapidly in the manufacture of vegetable oil and allied products.

London, as is the case with so many capital cities, is the leading manufacturing city of the British Isles because, as G. D. H. Cole says, "London's attractive power, as the focus of a great local market, as the capital of a world-wide empire, and as the principal money-centre of the world, has given it throughout the modern period an immense power to draw to itself all manner of economic activities that are not tied by natural conditions to a particular region." [1] There has been a great expansion of manufacturing in the metropolitan area since the World War. Coal may be obtained cheaply by water, but on the whole the industries are of a type that requires relatively little power. The leading industries are the manufacture of foods, furniture, and light metal products, printing and publishing, and the assembling of automobiles.

Foreign commerce. The economic life of Britain depends upon foreign trade. The British have more foreign commerce than any other nation, and provide the greatest market for the world's exports. Foods and raw materials are imported, and manufactured goods and coal are exported. There is also an important entrepôt trade—the collecting of products from many parts of the world and their subsequent distribution to the countries which use them. This trade is less important than it once was, because population has increased to the point in other countries where it is profitable to import many of the products direct. When the amount demanded is small or there is not the economic basis for a direct exchange, it is more profitable to collect such products at some large center where shipping lines to all parts of the world meet. Coal has always led in tonnage as an export. It provides a return cargo on the ships that bring in bulky goods but must take manufactured articles back. By this distribution of the freight charges the cost of both the imported and exported mate-

[1] "London—One-fifth of the Nation," *The Fortnightly*, January, 1937, p. 64.

rial is less than it otherwise would be. Many countries have thus been able to obtain coal, otherwise denied them by higher costs. Wool and food products each comprises about 20 per cent of the reëxports; hides and skins are two thirds as important. Nonferrous metals, rubber, and cotton are other items.

The recent abandonment of free trade by the British, and their Empire preference policy in foreign trade may change the direction of the foreign commerce to a considerable degree. Fifty per cent of the British exports and forty per cent of the imports are

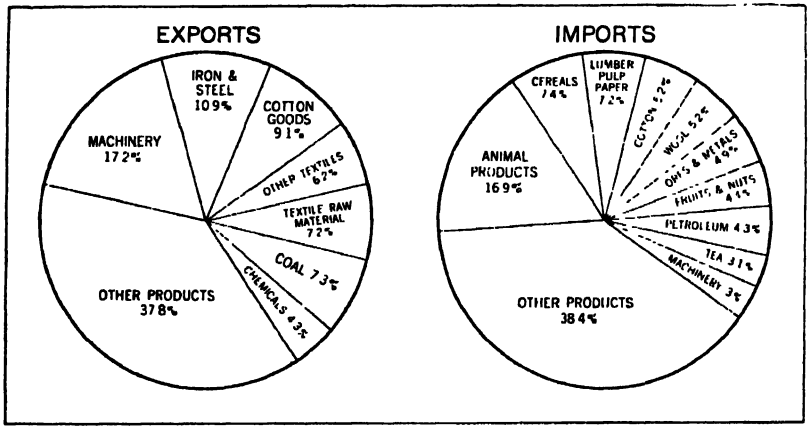


Fig. 148. Principal items in the foreign commerce of the United Kingdom, 1936.

now with the other parts of the Empire. The United States, Argentina, France, and Germany are also important in the trade.

Great Britain imports a much greater value in commodities each year than is exported, but the people make up the difference by performing various services for the people of other countries (Fig. 149), the payments for which are called invisible exports. In this manner the British, in spite of a so-called unfavorable balance of trade, continue to grow wealthier. Because of the great foreign investments of the British, many of the imports are simply the payment of the interest and the principal on these investments, or loans to the people of other countries. It should be observed that the extending of these loans with the surplus funds accumu-

lated in Great Britain is a very important factor in the continued ability of the British both to sell and to buy abroad.

Great Britain has many seaports for taking care of her commerce. London, Liverpool, and Hull rank in the order named, but there are several others with a large volume. Through London go about 37 per cent of the total imports and 16 per cent of the exports. The chief imports of the city are food and wool, the world's leading wool auction being located there. The location is convenient for trade with the Continent, and London is the distributing center for the entrepôt trade. The commerce of Lon-

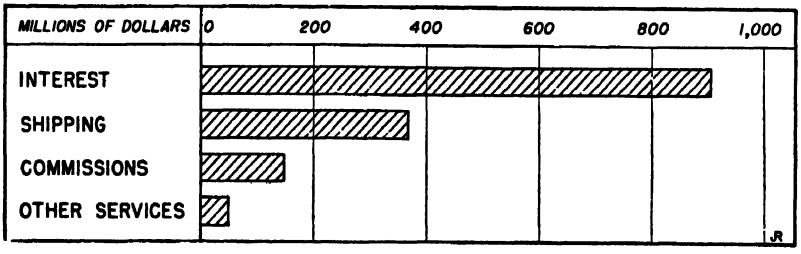


Fig. 149. Invisible items of British trade in 1935.

don has grown rapidly during the past several years, and in 1937 the Port of London Authority began a £12,000,000 program of modernization, some of the channels of the Thames being deepened sufficiently to admit boats drawing 33 feet of water; special unloading equipment and storage facilities are also being installed.

Liverpool is important in the trade with America, cotton and wheat being products whose world price is largely determined there. Glasgow is important in American trade also, particularly that with Canada. Hull is the outlet for Leeds and Sheffield and has an important trade with the Baltic region. Cardiff is the leading coal exporting port in the world. Because of its being the main port of call for large passenger liners, Southampton ranks after Liverpool in the entry of registered tonnage.

26

BRITISH AFRICA

AFRICA is near Europe, and most of it has been partitioned among various European powers; only Egypt and Liberia remain independent. In the majority of African possessions the mother countries exercise direct political control and monopolize the greater portion of the foreign trade. Consequently, Africa has no strong or independent country to set it apart from other continents in world affairs. For these reasons, discussion of these possessions is included with that of the mother countries, whereas similar interests elsewhere will be treated with their respective grand divisions.

British control extends over a third of the territory and a third of the people of Africa and includes, from an economic viewpoint, the most desirable parts of the continent. British Africa is about 20 per cent larger than the United States and contains 45 per cent as many people. It supplies 4 per cent of the total imports of the United Kingdom and is a market for 11 per cent of the exports.

BRITISH SOUTH AFRICA

Geographic features. The term *British South Africa* as here used includes all of the territory under British control from Northern Rhodesia southward. This region is largely a high plateau with a base of old, hard mineral-bearing rocks overlaid with sedimentaries, mineral areas occurring where the sedimentaries have been eroded. The plateau is highest on the south and east, the Drakenberg Mountains being its dissected escarpment, and decreases in elevation to the north and west. West of the mountains

lies the high veld, the higher, more moist part of the plateau; the low veld adjoins, and beyond that is the Kalahari Desert. Deep gorges, through which rivers flow, cut the plateau in several places and are an obstacle to overland transportation.

Climate. Roughly, the January and July isotherms of 68° mark, respectively, the southern and the northern edges of this region. Summer rainfall prevails, and a considerable portion has

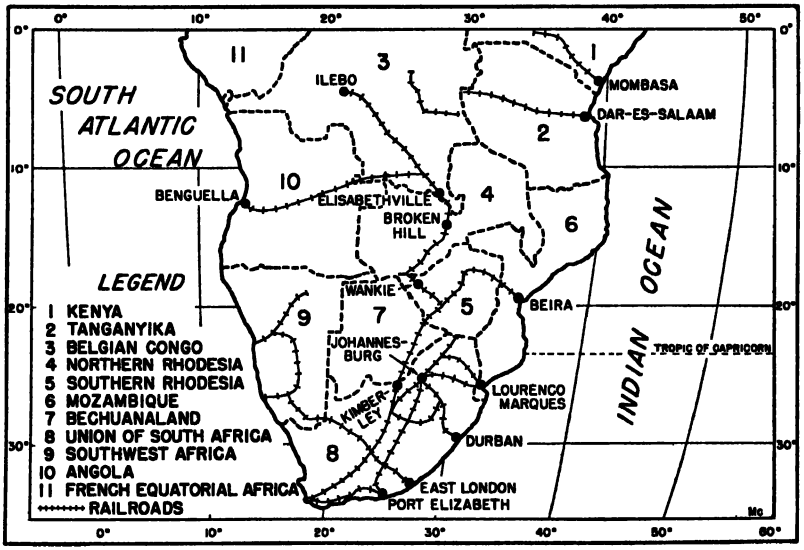


Fig. 150. Political divisions and the location of the principal railroads and cities of Africa south of the Equator.

a minimum of 30 to 40 inches. This is light precipitation for the latitude, but the influence is counteracted somewhat by elevation. Much of the west coast receives less than one inch of rainfall annually, the extreme aridity being caused by the cold Benguella Current. Through Northern Rhodesia rainfall increases gradually as the equator is approached. The southeastern part of British South Africa has the heaviest rainfall of any section because of the southeast trade winds and the mountains. After the winds pass over the mountains, they warm as they descend and blow toward the equator, and are, therefore, drying winds.

Minerals. Minerals, for which British South Africa is famous, exist in variety and abundance. There are yet many unexplored sections of mineral regions and the majority of the known ones have not yet been exploited.

For several decades from 40 to 50 per cent of the gold production of the world, and for the past decade an annual average of 46 per cent has come from a low range of hills in the Transvaal, called the Rand. The ore has a low gold content but exists in such enormous quantities that mining operations may be planned

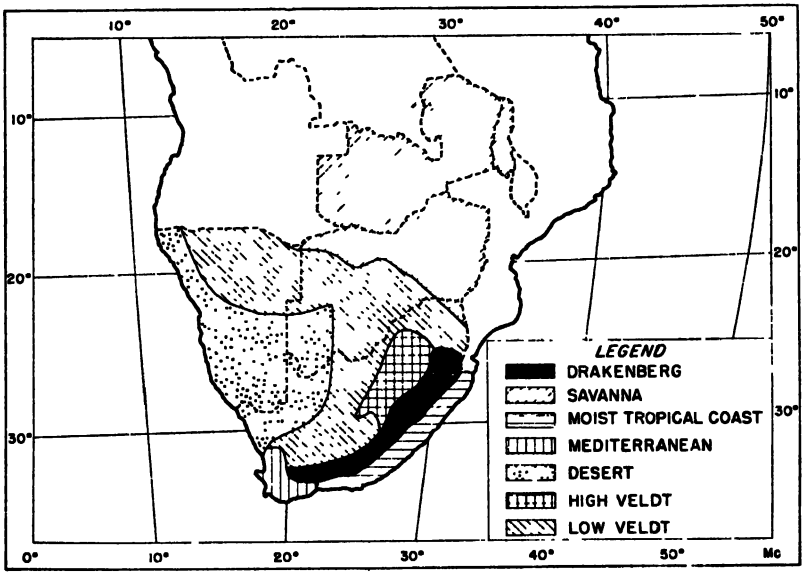


Fig 151. Natural regions of British South Africa.

ahead and be conducted on a permanent basis. Some of the mines are now so deep (one is 7,600 feet) that air-conditioning equipment is being installed to make it possible for the miners to work in them. This invention may extend mining much deeper than was formerly thought possible. The great part of the mineral production of Southern Rhodesia is gold.

The same general region which mines gold also leads the world in the output of diamonds, chiefly at Kimberley, but also at Pretoria, where the largest single mine is located. Eighty per cent

of the exports of Southwest Africa are diamonds taken from alluvial deposits along the coast north of the mouth of the Orange River. The diamond industry is monopolized by a few producers who control the output of the diamond mines in order to stabilize the price.

Next to gold, coal is the most important mineral wealth and in one way it is even more important than gold, because its presence has made possible the exploitation of the other minerals. The annual output is about 14 million tons, the leading fields being in the area between Johannesburg and the edge of the plateau to the north of Durban. The principal mining centers are Witbank and Middelburg, which supply the gold fields, and Newcastle, which supplies bunker and export coal through Durban, which is on the ocean route to India and Australia. In Southern Rhodesia the Wankie field supplies the Katanga smelters. The Luana Valley in Northern Rhodesia also contains coal.

Southern Rhodesia leads the world in the production of chrome ore and is second in asbestos. The former is largely from an area near Selukwe. The reserves of asbestos are known to be large. Northern Rhodesia contains many different minerals, but almost 90 per cent of the present production is copper taken from the region which borders the Katanga district of the Belgian Congo. There are important deposits of silver-lead ore at Broken Hill. Small amounts of lead, copper, tin, and vanadium are mined in the northern part of Southwest Africa, and gold and silver in Bechuanaland. In 1924 a deposit of platinum-bearing ore was discovered at Lydenburg in the Transvaal, and production is now more than $800,000 annually.

Agriculture. Although many crops are grown in southern Africa, it is not a good agricultural region, because of light and uncertain rainfall. The research that the British are conducting in long-range weather forecasting in this region may in time give the information needed to make a better adjustment of crops to the environment. There is considerable irrigation farming, the state aiding in constructing facilities for irrigation. On the

whole, the quality of the agricultural products has been low; but legislation has recently been enacted for the purpose of improving the quality of the exports.

Crops. Sixty per cent of the arable land is in cereals; corn, the staple food of the natives, is the most important. Some corn is exported to Australia and Mexico, and much is fed to cattle in the form of ensilage. The annual output is about 60 million bushels, and the yield per acre is only about one third that of the United States. The crop is not grown where the annual rainfall is less than 15 inches. The native kaffir corn is also an important food crop, the production being about one third that of corn. Basutoland, a well-watered, rugged plateau, is said to have the best conditions for corn of any part of southern Africa. The industry is expanding in the eastern part of the Orange Free State, where there are rolling plains with moderate rainfall. Wheat and the related cereals are grown in the dry subtropical region in the southwestern corner of the continent. Tobacco and cotton are other crops. Cotton is favored because it resists drought better than either corn or tobacco. Tea and sugar cane are grown along the tropical east coast near Durban and in Zululand.

Fruit growing is increasing because the fruit can reach the European markets during the northern winter months. It is shipped fresh under cold storage, and a great quantity is canned, preserved, and dried. Grapes and middle-latitude fruits are grown near Cape Town, tropical fruits near Durban, and citrus fruits near Durban and Cape Town, in northeast Transvaal, and in Southern Rhodesia, where the acreage has been expanding rapidly.

Animal industries. Its dry nature and uncertain rainfall make South Africa preëminently a grazing region. Sheep, goats, and cattle are all important. The cattle are in the warmer and more moist eastern and northern sections, chiefly the former, but they are increasing in numbers in the Rhodesias. Northern Rhodesia sells animal and also vegetable products to the Katanga mining

district. Dairying is also making a start in the Union and in Southern Rhodesia, and there is a small production of butter in the more moist parts of Southwest Africa and Bechuanaland. The tsetse fly and the rinderpest are obstacles to cattle raising in several of the warmer sections.

Sheep outrank other livestock in importance. Goats are also numerous, and South Africa leads the world in the production of mohair. Like cattle, sheep and goats tend to concentrate in the more moist southeast (Fig. 152). On the better ranges an acre or

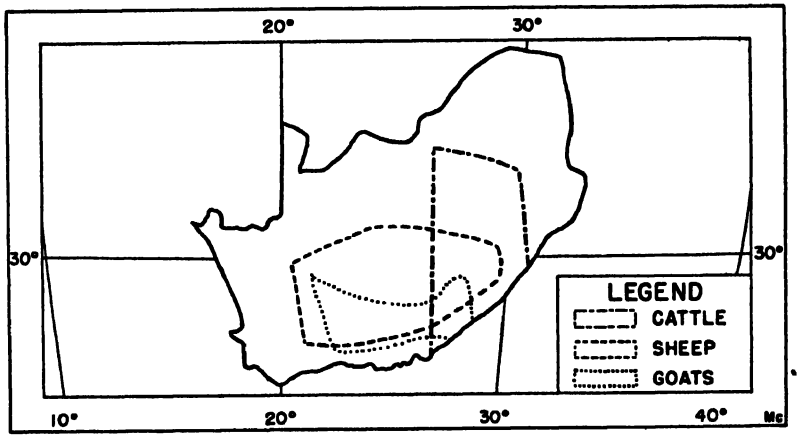


Fig. 152. Principal animal-producing areas of the Union of South Africa.

less will pasture a sheep, while on the driest ones 8 acres or more are necessary. Recently, through more dependable water supplies provided by drilled wells, the sheep industry has been extended westward into areas where previous lack of water had made occupancy impossible. Though supplies of artesian water are lacking, there are large quantities of water a few feet under the surface. The sheep of South Africa are a cross between a native fat-tailed sheep and those imported from Europe and Australia. Until recently the quality of the wool has been poor, but the recent importation of breeding stock from Australia has resulted in a better quality.

Ostrich growing, for the plumes, is located at Oudtshoorn,

where the birds are pastured in fields of alfalfa. The prosperity of the industry fluctuates with changes in styles and with economic conditions in the main buying countries.

Manufacturing. Manufacturing consists chiefly in smelting and concentrating minerals and working up various raw materials into goods for the domestic market. There are four important centers: at the gold fields around Johannesburg, in the vicinity of Cape Town and Port Elizabeth, at Durban, and near the coal fields of Natal. Germiston, in the gold fields, has the largest gold refining plant in the world. It also has carbide, engineering, and cement works, and plants making corn products and cattle foods. A government steel plant has been built at Pretoria to increase the production of coke. Cape Town is a great center for the making of leather goods, tobacco products, sugar, and canned foods. Newcastle and Vereeniging both have iron and steel plants.

Several factors favor the region as a future manufacturing center. It has many raw materials and can produce others, many of which should be processed near production centers. Although the total quantity is not large, South Africa has 95 per cent of the coal reserves of Africa. Much hydroelectric power might also be developed within the region, and it might not be too much to expect that someday the vast water-power resources of the Belgian Congo could be used in South Africa. Furthermore the region, somewhat isolated, produces almost enough variety of commodities to become largely self-sufficient. The nationalistic ambitions of the South Africans might lead them to make an extensive use of the protective tariff. Since the territory will support more white people than it now has and since the present large native population has a low standard of living, a greater home market may develop in the future.

Transportation. Although there are already fairly good railway facilities in the southeast and new lines are being constructed, still more are needed. The Cape to Cairo line is important, for it

connects lateral railways which lead out to the coast. The present lines were built primarily to tap mineral centers and on this account often have a zigzag course, built as the different mineral deposits were discovered. Recently a railway has been built by British capital from Benguella in Angola to the Katanga district, which will help to develop Angola as well as the minerals farther east. A new bridge over the Zambezi, costing $10,000,000, connects Lake Nyasa with the port of Beira in Mozambique. Motor roads also have been provided in the more settled parts of South Africa.

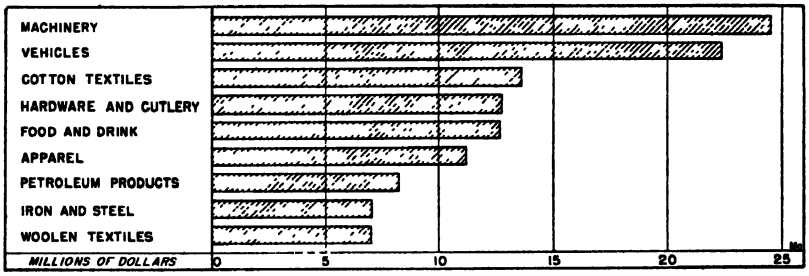


Fig. 153. Principal imports of British South Africa in 1935.

Foreign commerce. The bulk of the foreign trade of British South Africa originates in the Union of South Africa. Since the principal exports, gold in 1935 accounting for 72 per cent and wool for 10 per cent of the total, are products with a high per capita output, their producers can purchase large amounts of imports. Nearly all of the exports go to the United Kingdom, many of them being reëxported from there. About half of the imports are from there. This region contributes about 2 per cent of the total British imports and is a market for 8 per cent of British exports.

The leading seaports are Cape Town on the southwest, which serves the Union and Rhodesia, and Durban on the east. The former has the greater trade, but Durban ranks first in handling imports. Other ports are Port Elizabeth and East London. Lourenço Marques in Mozambique also ships much transit trade for

British territory. On the west coast Walfish Bay is being developed as the leading harbor.

BRITISH WEST AFRICA

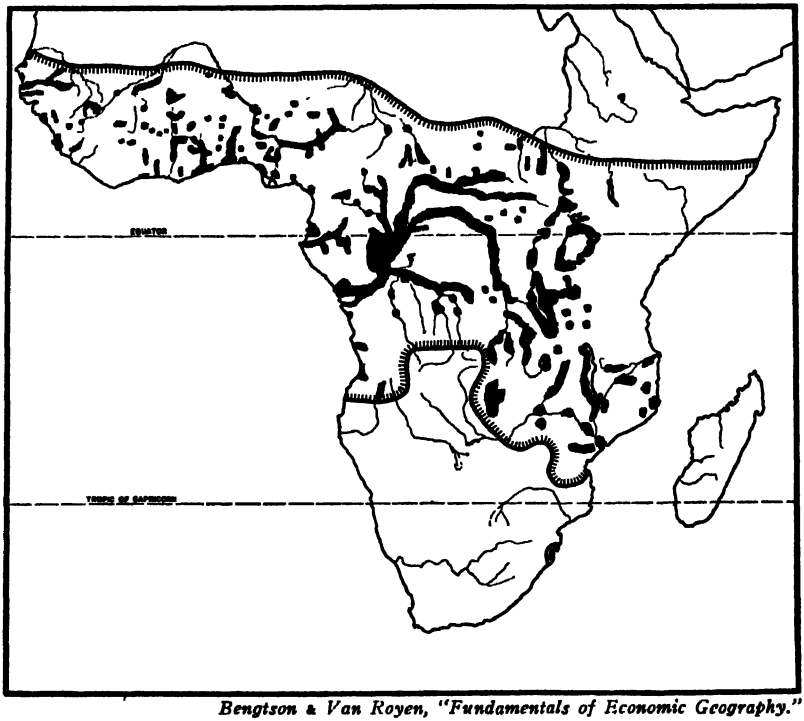
Importance. Of the British possessions in equatorial Africa, the Gulf of Guinea region is the most important commercially. It produces tropical products which are much in demand in the colder countries, and it is said to have rich opportunities for expanding production; it has the best location, being on the side of the continent that is nearest to Europe and the United States; and it has an abundant supply of fairly dependable and efficient workers. This region is said to be more important to the home country for raw materials than any other possession, save India.

Geographic features. British West Africa consists largely of a sandy coastal plain from 100 to 150 miles in width and small areas of plateau which face the incoming winds and thus have rain at all seasons. Northward it merges into the savanna, the boundary being the zone between the lands which have only summer rain and those which have rain at all seasons.

Diseases. Germ diseases and insect pests are a great obstacle to progress in all parts of equatorial Africa. Malaria is widespread, though the natives seem to be immune to it. The sleeping sickness, which is carried by the tsetse fly, attacks both white and native alike, and also the animals. The tsetse fly can be hatched only in water or in damp places and is found along the courses of streams or near the lakes. Sleeping sickness has recently killed large numbers of natives, and a serious shortage of labor has resulted.

Crops. The food crops of the natives are rice, manioc, and corn. The principal commercial products are cacao and palm oil. Cacao, the fruit of a native tree of tropical America, is used for making chocolate and cocoa. Palm oil is obtained from the fruit of a tree native to this section of Africa. It is employed in making soap and also as a bath in the manufacture of tin plate. Cacao is

obtained chiefly from trees grown on plantations, while palm oil is harvested from wild trees. The Gold Coast produces one third of the world's cacao and Nigeria produces over half of the palm oil. It is said that the oil palm offers the most immediate possibilities of any of the products that grow in the region. There are many rubber trees in the forest, while hardwoods



Bengtson & Van Royen, "Fundamentals of Economic Geography."

Fig. 154. Distribution of tsetse flies.

abound, and large areas are covered with mangrove trees. About 80 per cent of the exports of Gambia are peanuts, which are sent to the centers in Europe that manufacture vegetable-oil products.

Large areas in Nigeria are adapted to cotton, and the British have encouraged the natives to expand the acreage. Along the Niger and Benue Rivers back of the highlands there is plenty of rain, fertile soil, and transportation facilities. River navigation is good, there are some railways, and the British have built motor

roads. Another possible cotton area is around Lake Chad, one of the most inaccessible parts of western Africa. The natives grow cotton and grain around the edges of the lake during the dry season. An excellent black cotton soil goes unused because the natives grow the crop, all for domestic use, on lighter soils. This region also has possibilities for cattle production, whenever the tsetse fly can be controlled. Some hides and skins are exported.

Minerals. Near Bauchi, in the plateau by the same name, Nigeria has 9,000 square miles of tin-bearing territory, and has coal at Udi. There is a small production of both. The leading mineral is gold obtained from the alluvial deposits and underground mines of the Gold Coast.

Transportation. British West Africa is handicapped by lack of transportation facilities. The rivers are often shallow and obstructed by falls. Since their mouths are cut off from the ocean by a line of sand bars, lighters are necessary for a mile at sea. Railways, difficult to build, are usually not profitable. Many motor roads have been built, especially in the oil palm districts. There are several caravan routes, with Kano, in northern Nigeria, an important caravan headquarters (Fig. 166).

Foreign commerce. The main imports of this region are textiles, iron, steel, machinery, tobacco, and petroleum. Most of the trade is with the United Kingdom, followed by the United States and the German Reich. The United States is an important market for cacao, Germany for oil palm products, the two products which, with gold, comprise most of the exports.

Lagos, Port Harcourt, Accra, Freetown, and Bathurst are the principal seaports. Nearly all of the cacao is exported through Accra.

BRITISH EAST AFRICA

Geographic features. British East Africa, sometimes called the lakes region, is predominantly a high plateau. The only large area of coastal plain, in Kenya, is a dry region and not so important commercially as are the highlands.

There are several tropical lowlands along the rivers and lakes. Although in general the soil is poor, there are many fertile spots. A particular feature is the rift valley, which can be detected from the finger-like shape of the several lakes which are in it. It begins at the junction of the Red Sea and the Gulf of Aden, which themselves occupy rift valleys, and extends as far as Lake Nyasa. Another such valley starts with Lake Albert and joins the other at the northern end of Lake Nyasa. These valleys have been important avenues of transportation. Lakes such as Victoria are not rift lakes; they occupy depressions in the plateau. The shape and location of most of the larger lakes of this region fit them for transportation.

Climate. In spite of high elevations in most parts of this region, the climate is warm at all seasons. However, there are large areas in which white people might live. There is considerable variation in temperature because of differences in altitude. Rainfall is not heavy, except near the lakes and at the higher elevations. The districts around Lake Victoria and on the west side of Lake Nyasa both have heavy rainfall. Toward the northeast, desert conditions are approached.

Forests. There are all types of forest products which may in the future provide large amounts of exports. Small quantities of ebony and other hardwoods are now exported from the lowlands. Kenya and Tanganyika both have large areas of deciduous and coniferous trees; both export pencil cedar, of which, in Kenya particularly, there are large areas. The forests of Kenya, set in the highlands, are nearly all coniferous. The exporting of bamboo for making paper is another promising industry, as is the exporting of mangrove and wattle for making tanning extracts.

Crops. Advantages which this region possesses for the production of crops are (1) the range in elevation, which makes a variety of crops possible, and (2) the large native population trained in agriculture. The highlands are more important for agriculture than are the lowlands, crops growing in altitudes of 9,000 feet.

At present cotton, grown chiefly in Uganda and Tanganyika,

is the leading crop; Uganda, where the crop is grown on small farms by the natives, has more than a million acres. British attempts to encourage cotton production in suitable parts of the Empire seem to have been more successful here than anywhere else. The upland variety of cotton grown in all parts of British Africa is of better quality than in the United States—an important consideration for British textile manufacturers and for American cotton growers.

The other important crops are grown partly on plantations under European management. Coffee is an important export from all of the countries of the region; tea and tobacco are grown in Nyasaland; sisal, groundnuts, and rubber are exported from Tanganyika, and sisal also from Kenya.

The coral islands of Zanzibar and Pemba grow nearly all of the world's cloves, having 48,000 acres in the crop. The clove is the dried unopened bud of an evergreen tree that would have, if the bud were allowed to open and mature, a fruit similar to the olive. The trees are grown on plantations, owned largely by Arabs.

Large areas in British East Africa are suited to grazing, and the British think that some day this region will become the meat basket for the mother country. Tanganyika now has more food animals—cattle, sheep, and goats—than any of the other countries. Wool and hides and some dairy products are exported from Kenya.

Transportation. The lakes of British East Africa, generally important for moving both local and export traffic, are, in several places, the only means available. They are connected by river and by rail with the ports on the coast. Some of the rivers are navigable by shallow-bottom boats for considerable distances. A much greater mileage of railway is needed, although motor roads partially overcome the lack of railways.

Foreign commerce. Figure 155 shows the principal exports of this region. The imports are of the same classes as those given for western Africa, and trade is largely with the mother country.

Important ports are Zanzibar, Dar-es-Salaam, which, being on the mainland, is now growing at the expense of Zanzibar, and Mombasa. Zanzibar early became important as a distributing and collecting center for the mainland. Situated on an island, it was more healthful for living than the mainland, and the city was also better protected from the attacks of natives. Mombasa, on a coral island, has one of the best harbors, Kilindini, on the east coast of Africa. It will accommodate ships of deep draught, and

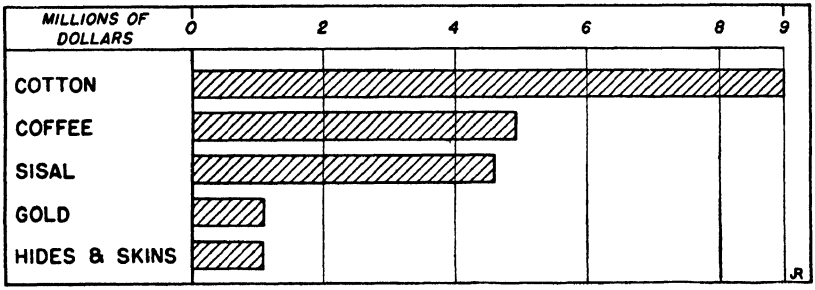


Fig. 155. Principal exports of British East Africa in 1935.

is landlocked and sheltered. A bridge connects Mombasa with the mainland.

THE ANGLO-EGYPTIAN SUDAN

Geographic features. The best part of the Anglo-Egyptian Sudan is the basin of the White Nile. In its southern part it is heavily forested, and, when the flood waters of the Blue Nile cause the waters of the White Nile to back up, the basin contains many lakes and swamps. Rainfall gradually diminishes northward until below Khartoum extreme desert conditions prevail. Between the desert and the equatorial region is a Sudan grassland with great possibilities for grazing.

Products. In the forested section tropical woods abound and there are enormous supplies of papyrus which might be used for making paper. Much of the papyrus, which floats in great masses in the rivers, is an obstacle to navigation. From both wild and

cultivated acacia trees is derived gum arabic, in the production of which this country leads the world.

Along the lower part of the White Nile several crops are grown either during the rainy season or under irrigation. The staple

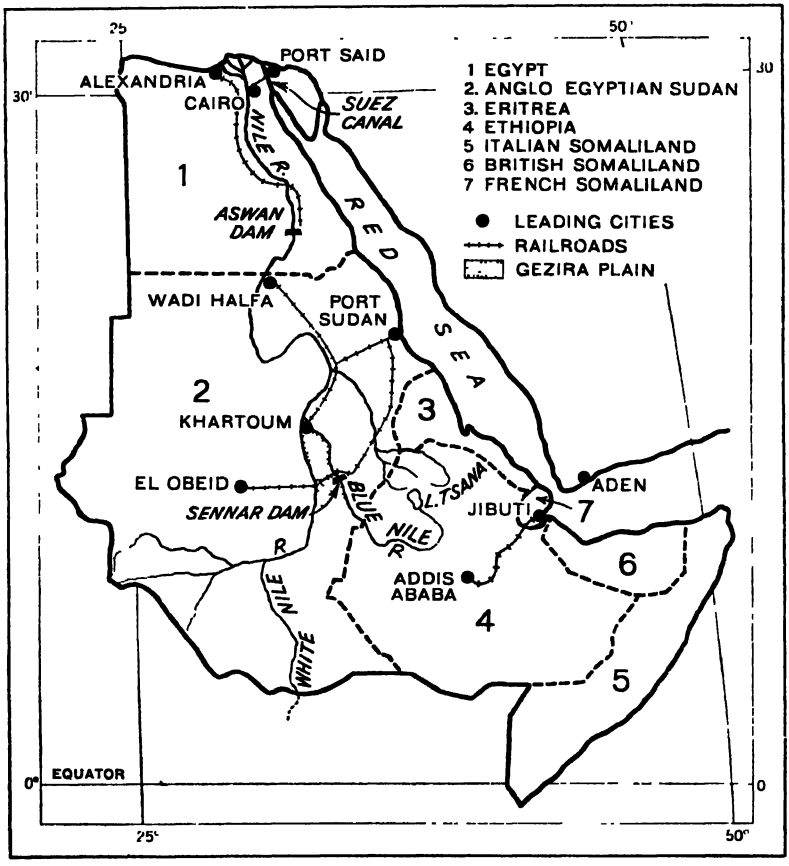


Fig. 156. The Nile region and the horn of Africa.

food crop is *dura,* a sorghum whose grain is eaten either in the form of porridge or cakes. An alcoholic drink is also distilled from it, and the natives chew the stems of the plant for sugar. Oilseeds, sesame being most important, are another crop. Between the White Nile and the Blue Nile is the fertile Gezira plain (Fig. 156), which will grow almost any tropical crop if water is applied. The British hope that some day it will rival

the Egyptian section of the Nile in agricultural development, particularly in the growing of cotton. It has been planned to have ultimately 3 million acres of this plain under irrigation. In furtherance of this plan the Sennar Dam was completed on the Blue Nile in 1925, and at present another dam with greater capacity is being built on the White Nile 24 miles below Khartoum. Present cotton production is less than 200,000 bales on a little more than 300,000 acres. About one third of this is produced without irrigation. Egyptian and American long-staple varieties are grown. Other obstacles to cotton production are the lack of transportation and of labor. Railways are gradually being built, the

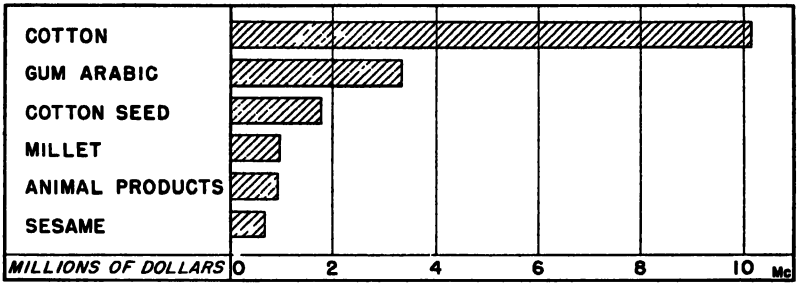


Fig. 157. Principal exports of the Anglo-Egyptian Sudan in 1935.

most recent one being the Kassala Railway, which connects Sennar to a line which goes to Port Sudan. Wars, disease, and drought have reduced the population by 80 per cent during the past half century. The natives are not inclined to grow cotton. A recent treaty between Great Britain and Egypt gives Egyptians the privilege of settling in the Sudan.

Transportation. There are several short railway lines and motor roads which connect different sections and provide service into the Belgian Congo, and there is a fleet of government steamers on the Nile and its tributaries between Aswan in Egypt and Rejaf.

Foreign commerce. Figure 157 shows the exports of the Anglo-Egyptian Sudan. The imports are of the same classes as given for equatorial Africa. The trade is largely with the mother

country and Egypt. The latter does a great deal of transit shipping. Some products move by boat down the Nile, while others move by rail to ports on the Red Sea, Port Sudan being the most important.

SIGNIFICANCE OF POSSESSIONS TO THE BRITISH

Africa is largely unexploited and unexplored and is sparsely populated by people with a low standard of living, but its comparative unimportance in the present foreign commerce of Great Britain is no criterion of its future significance to that nation. It is, however, of greater importance than is apparent in the trade statistics because of the large volume of raw materials that help to keep British factories and British labor busy, these materials being made into manufactured goods to supply the domestic and the far-flung foreign markets.

There are also problems in connection with these possessions. The territory is widely spread and is on the whole the most desirable in Africa. It is, therefore, coveted by others, and it may be difficult to hold it against a combination of unfriendly powers. Another problem is that of native uprisings, for the natives both resent the presence of the whites and are aware of the fact that they outnumber the whites. The problems of government vary from those of the Dominion status of the Union of South Africa, whose people demand and have considerable autonomy, to those of the absolutism of such colonies as the Gold Coast, and to the uncertainty of the mandates. Great Britain is responsible to the League of Nations for the former German colonies now held under mandates. There is considerable feeling, particularly in the Union of South Africa, against permitting these mandated territories to leave British control, because their control by an unfriendly power would be a menace to the safety of British territory.

27
FRANCE

Area and population. France is 75 per cent larger in area than the British Isles, but has only 80 per cent as many people. Furthermore, it is as large as the combined areas of Iowa, Illinois, Indiana, Ohio, and West Virginia, and has twice the population. This should be considered in connection with the fact that France is largely an agricultural country, and the most sparsely populated among the important countries of northwestern Europe.

Reasons for importance of France. Several influences contribute to the importance of France among world powers. Although the country has some effective natural boundaries, it is the crossroads of Europe, the meeting place of east-west and north-south routes. The main east-west route is along the plain and through Belgium, but there are several others that enter from the Alps and at various points between the Alps and Belgium. The only important breaks in the mountain along the Mediterranean are the Rhône Valley and the Toulouse gateway, both in France. Paris has more natural routes centering on it than any other city in Europe. This convergence of routes has brought invasions by armies but also people from many other countries, with the usual benefits of many contacts, and has been an important commercial advantage, for the location with respect to water and important world trade routes is more favorable than that of any other country. The importance of the Mediterranean front is shown by the fact that Marseille is the leading seaport of France.

The self-sufficiency of France has also been a favorable influence. This results from the great variety in climate, soil, and topography and from the relatively large proportion of level, pro-

ductive soil. Varied interests are thus brought together within one political unit. There is probably no other area of equal size in the world which has such a variety of geographic features and influences.

A major influence, also, has been the type of people, largely of the Mediterranean stock, which is famous for its artistic temperament. The French are noted for finesse in their work, preferring perfection in the finished article rather than efficiency in the methods of making it. They wish, furthermore, to avoid undertakings with undue risk, holding rather to that which is established. This should be contrasted with the British willingness to take a risk, and should help to explain much of the progress of the latter in industry and in colonization.

Geographic features. While there is considerable topographic diversity in France, more than half of the country is a productive plain with a good climate for agriculture. The remainder includes several highland areas of varying geological origin, and with climatic and soil conditions that make them better adapted to grazing than to crops.

The Paris Basin, the Aquitaine Basin, and the Rhône-Saône lowland are the level to gently rolling areas. The first, economically the heart of France and comprising a quarter of the area, is geologically similar to the scarplands of southeastern England. It is a former arm of the sea that has undergone submergence several times, and hence is composed of a variety of formations, which dip gently toward Paris in the center. Dissected escarpments of chalk and limestone, which have been a major factor in the military defense of Paris, occur where the formations outcrop. As in England, they are dry and make good sheep-grazing lands. The famous Champagne wine district is on the southeastern slope of one of the chalk escarpments. Between some of the outcrops are clayey to silty plains, which are good for crops or cattle grazing; between other outcrops are limestone and chalk plains, which are fit only for sheep grazing or forests. Some of these were the scenes of important battles of the World War.

Forests are also found where sandstone outcrops, as near Paris and in the southern part of the basin.

The Aquitaine Basin, more rugged than the Paris Basin and with a warmer climate, is the only part of northwestern Europe where corn can be grown successfully. In the southern part is a

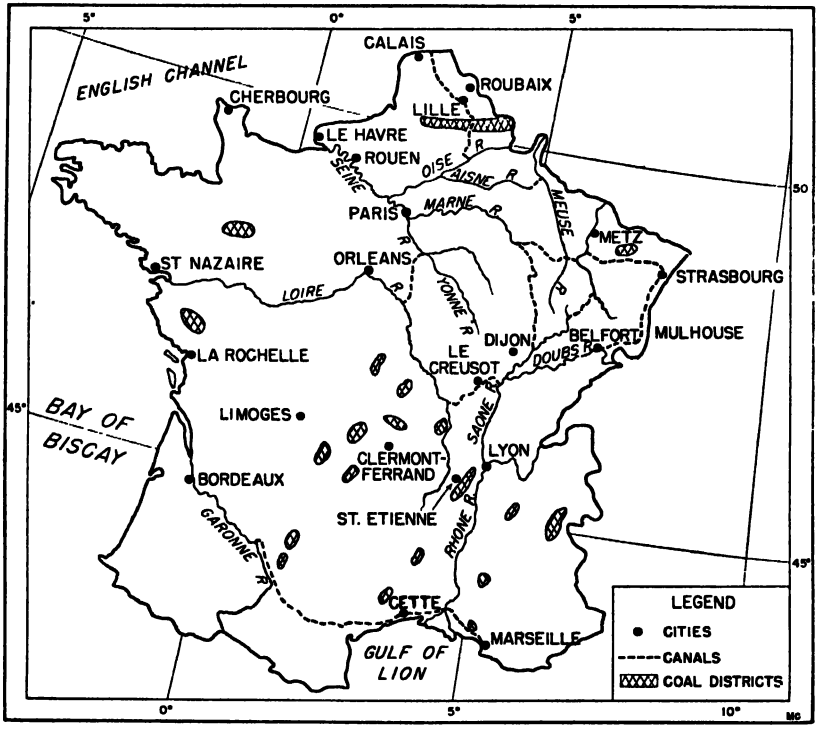


Fig. 158. France.

deeply dissected plain of alluvial and glacial materials from the Pyrenees. The valleys through this basin are very fertile.

The Rhône-Saône lowland, including the small Mediterranean plain, is one of the most important natural routes of Europe. It connects with the Rhine Valley by way of the Belfort Gap, and with the Paris Basin through a pass near Dijon, an important route center, and by way of the Aquitaine Basin through the Carcasonne Gap and the Poitiers Gate. The Rhône Valley was formerly an arm of the sea, and the Saône Valley, a lake formed by

glacial obstructions near Lyon. The lower Rhône Valley and the small Mediterranean plain are the only parts of France with a Mediterranean climate. Low-pressure conditions over the Mediterranean during the winter give rise to a cold wind, the *mistral,* which blows down from the highlands of central France, limiting the growing of winter crops along the Mediterranean, except in the Riviera, which is protected by the Alps.

The highlands of France are along the eastern border, in the central part, along the Spanish border, and in the northwest. Their climate is more severe and extreme than that of the plains, and they are important mainly for their forests, grazing lands, minerals, and water power. These highlands are quite effective natural barriers. Their distribution has been an important factor in the development of the water-power resources.

Climate. On the whole, France is well watered and its temperatures are moderate. The several areas of highlands have important modifying influences. The west has an oceanic climate with the higher summer temperatures toward the south. The climate of the Paris Basin is much like that of its counterpart, the English scarpland. Eastward the conditions become more like those of central Europe; that is, the seasonal range from winter to summer is relatively great.

Forests. About 20 per cent of France, chiefly in the highlands of the south and east, is forested, and in the interests of agriculture in the river valleys it is important that these highlands remain in forests. Although the French are not so scientific in the use of their woodlands as are some of the other countries of Europe, they do give them considerable attention. Because of the scarcity of coal, wood in many places is important for fuel.

Along the southwestern coast is a barren swampy district that has become an important source of naval stores. The region was formerly one of shifting sand dunes which were a menace to fertile agricultural lands farther inland. A native pine was set to fix the dunes, and the region has since become prosperous, selling timber as well as naval stores.

Minerals. In spite of the fact that France possesses the largest iron-ore reserve in Europe—a fifth of the total for the continent—the country is not richly endowed with mineral wealth. The lack of coal has been one of the most serious disadvantages. The coal deposits in the Valenciennes Basin in the north, which are an extension of those of Belgium, supply almost the entire production.

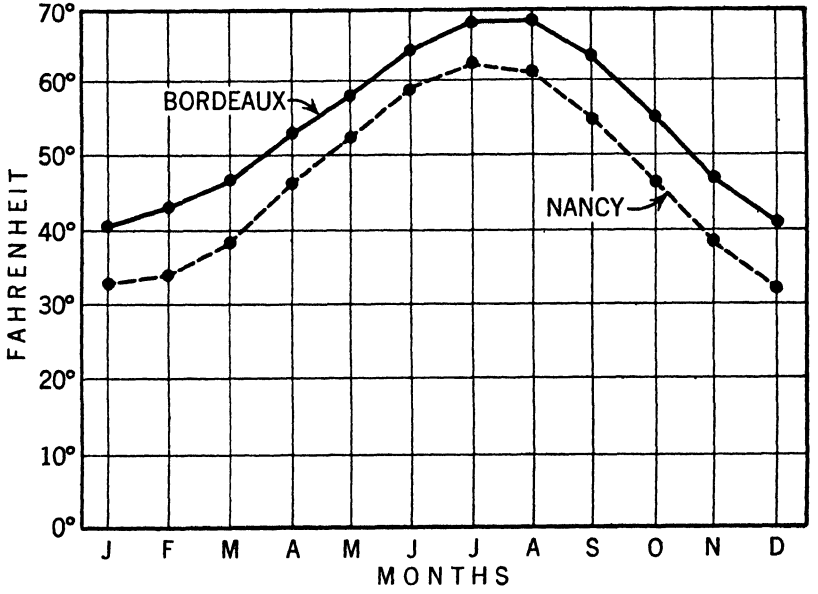


Fig. 159. Mean monthly temperatures of Bordeaux and Nancy.

Smaller deposits are found in pockets around the edge of the central highland at Le Creusot, St. Étienne, and Alais. The northern deposits have been folded much and the coal has been pulverized; consequently, they are expensive to mine. Situated favorably for importing coal from both Great Britain and Germany, France usually imports half of the total consumption. Sixty per cent of the traffic at Rouen consists of coal.

The main deposits of iron ore are in Lorraine near Briey and Nancy, with smaller ones in Normandy, the Pyrenees, and the central highland. The lack of coal causes much of this ore to move to Germany for smelting and manufacture; but France has

a large iron and steel industry, because coke may be brought back in the cars which haul iron ore to other places, and because the relative rates on iron ore and coke somewhat favor the movement of the coke to the iron ore. Furthermore, low-grade ores require less fuel per ton of ore for smelting than do the high-grade ones, and they produce more slag from smelting. These factors tend to move smelting to the supplies of ore.

At present France mines about 25 per cent of the world's bauxite in the provinces which border on the Mediterranean and on northeastern Spain.

France ranks next to Germany in the production of potash, from deposits at Cerney. Much of the salts is sent to the chemical-manufacturing centers of Germany. Petroleum is obtained from sands at Pechelbroun.

Water power. The lack of fuel has forced the development of water power chiefly in the Alps, and to a lesser extent in the Pyrenees. The Vosges and Cevennes have small quantities, and power is developed from the tides along the coast of Brittany. Some of the railways now operate with hydroelectric power, and plans have been made to electrify the entire railway system. France has 9 million horsepower of potential water power, almost as much as Norway, but has developed only about 25 per cent of it. In the Alps region electricity has made it possible to do a great deal of manufacturing in the homes, St. Étienne being a center for such manufactures.

Fisheries. France employs about one third more people in fisheries than the British Isles employ, but the catch is usually only about 60 per cent as valuable. Fishing is conducted on all of the coasts, and nearly every seaport has a fishing trade. The leading center is along the north coast, where the fishers bring in the cod and herring from the North Sea. On the west coast, with La Rochelle as the center, sardines, tunny, mackerel, and oysters are important catches. In the Mediterranean the tunny is the leading species caught, Cette being the center of the industry. Many Frenchmen also go as far as the Grand Bank to fish.

Agriculture. About 40 per cent of the land area of France is arable and in crops, and 25 per cent is in permanent meadow and pasture. About 40 per cent of the people are engaged in agriculture. The lack of large supplies of coal has prevented industrialization, but the fertile soil, excellent climate for agriculture, French temperament, small holdings, and a national policy of maintaining an even balance between agriculture and manufacturing have also held the people to the land, which is divided among 4,000,000 holders. The average farm contains 24 acres. Such small farms probably result in much inefficient production, but for long the French law of inheritance caused the farms to become continually smaller. This should be contrasted with the law of primogeniture in England, where the eldest son inherited the family fortune, and the younger sons shifted for themselves. This law was one reason for the extensive colonization of the British: the younger sons, having nothing at home, went out into the world to make their fortune. Protective tariffs on agricultural products have also been important in keeping France an agricultural country, at least in making the agriculture varied. As a result of these influences France is about 80 per cent self-sufficient in food products.

Crops. Usually about half of the crop land of France is planted in cereals, and, by tradition and national policy, wheat is the leading crop. Sixty per cent of the crop is grown in the Paris Basin. The country is usually self-sufficient in wheat and sometimes has a small export. The output ranges from 30 to 40 per cent as great as that of the United States on about 25 per cent as much acreage. Oats, production of which is about one third that of the United States, also are grown largely in the Paris Basin. Sugar beets are an important crop in the plain of Picardy, where cheap Belgian labor is available; the output of beet sugar is about equal to that of the United States. Hay and forage crops occupy almost as much acreage as wheat, and are most important in the highlands and coastal margins which surround the wheat district. Rye, barley, and potatoes are grown chiefly on the poor soils of the

central highland and Brittany. Potatoes are grown in both sections; barley is concentrated in Brittany, and rye in the central highland. Potatoes are an important crop, production being about 50 per cent greater than that of the United States on only a slightly greater acreage. Apples are grown along the coast of Normandy. Cider is an important drink in northern France, which is beyond the limit of successful grape production.

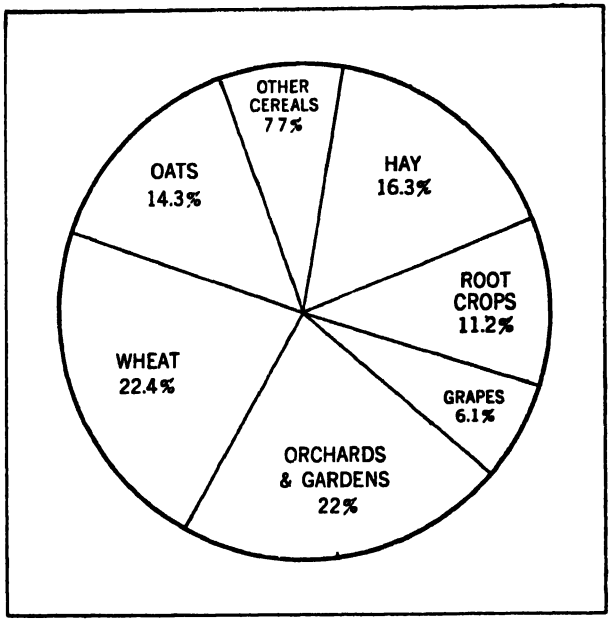
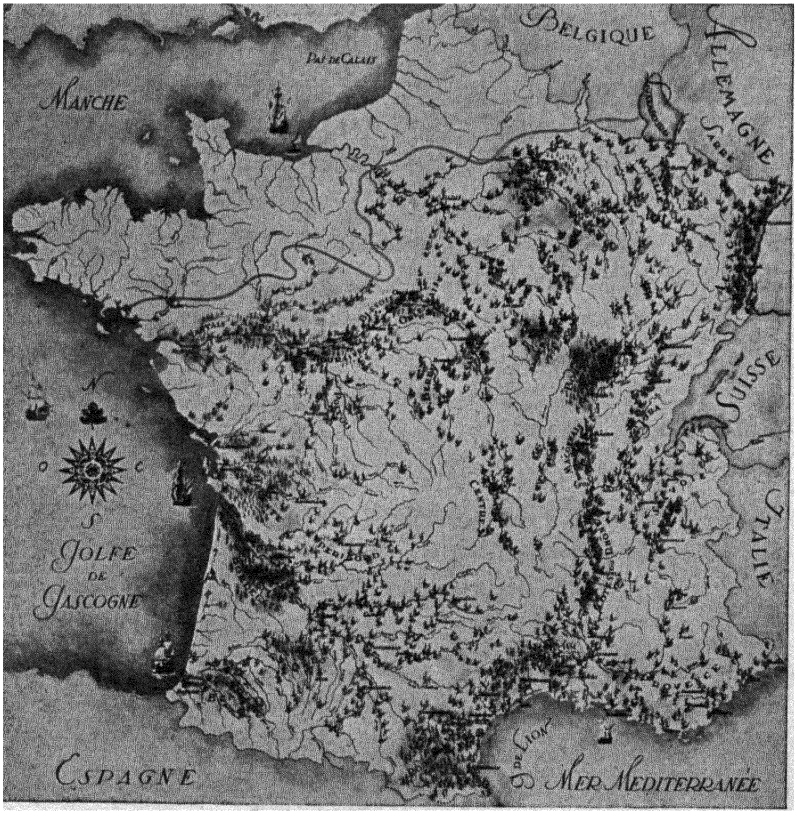


Fig. 160. Relative amounts of land in crops occupied by different crops in France in 1936.

In the warmer parts of the country, corn, mulberry trees, citrus fruits, olives, winter vegetables, and flowers are grown. Corn is cultivated in the Aquitaine Basin and in Burgundy. Production now averages about 22 million bushels annually. In the Rhône Valley are grown mulberry trees for the production of silk, which has declined much during the past several years. The remaining crops are grown along the protected Riviera, and winter vegetables for the British market are grown also along the coast of Brittany, where seaweed and shells are used for fertilizer.

The grape-growing industry. France leads the world in both the quantity and quality of wine. Each section (see Fig. 161) has a distinctive wine, owing to differences in soil and climate, while the high quality is the result of skill in manufacture and of the cold winters which are necessary for curing. Champagne, how-



Comité National de Propagande en Faveur du Vin, France.
Fig. 161. Chart of the wine districts.

ever, is cured in deep limestone caves where an even temperature is always maintained. The French are also large importers of wine, often exporting their own and consuming the imported variety, which is of poorer quality, or mixing it with their own better wines.

Animal industries. Animal industries are relatively important in France both because of the cool, moist climate and much rolling land, and because of the desire of the people for self-sufficiency. Beef production and dairying are both important in Brittany and Normandy, and to a lesser degree in the northern or better watered part of the central highland. Sheep are grown chiefly on the dry limestone ridges in the region of Paris, in the drier parts of the central highland, and in the Rhône Delta, being pastured in the delta during the winter and taken into the mountains during the dry, hot summer. Sheep raising has always been an important industry, and as a result France has ranked as one of the leading wool-manufacturing countries. Swine are grown in the same regions as cattle. France is famous for her fine draft horses; the slopes of La Perche in Normandy, where the climate is mild and moist and the soil good for grass, form one of the best regions in the world for growing horses. Here is the native home of the Percheron breed which is used so widely for farm work in the United States. Before the World War many horses were sold to buyers in the United States for breeding purposes.

Manufactures. The lack of important reserves of coal in France has prevented the extensive development of heavy industries. The manufactured products are characterized by their high quality, which represents the imparted skill and artistic abilities of the people. To compete with countries more favored by natural resources for manufacturing, France has had to raise the quality of its products into a class where there are few competitors. They are style and luxury articles, whose sale is affected much by fads and fashions and by periods of business depression. Since the World War, however, France has made much industrial progress and has become more important in the heavier industries. For a while reparations coal from Germany and, until recently, the control of the Saar Basin provided a greater supply of coal than formerly had been available. Progress has resulted also because the factories destroyed by the War were replaced with larger and

more modernly equipped ones, while at the same time there has been a great increase in the use of water power.

The leading manufacturing district is the area to the northeast of a line connecting Nancy and Rouen. Here are the main supplies of iron ore and a network of waterways (Fig. 158), which permits cheap importing and exporting. Another important center is in the Rhône Valley. There are in addition other centers, which will be mentioned shortly.

The manufacture of textiles—cotton, wool, silk, and rayon—is the leading industry, followed by the manufacture of iron and steel. Both industries are located generally in the same areas, although various cities tend to specialize. The whole region surrounding Lille is important for iron and steel, cotton, and woolens. Lille, the leading iron and steel center of France, is also important in cottons; Roubaix and Turcoing are important primarily for woolens, but they also make cottons. Valenciennes makes lace and cambric linen. Rouen, near the mouth of the Seine, and Belfort and Mulhouse in lower Alsace, where coal from the Saar Basin and water power are obtainable, and Orleans are other cotton centers. Alsace has almost a quarter of the cotton spindles of France. Nancy and the Briey Basin manufacture steel.

In the Rhône Valley, St. Étienne makes nearly all of the small firearms for the French Army, and Le Creusot is important for ordnance. Lyon, St. Étienne, and Alais manufacture silk, Lyon ranking next to Milan. The bulk of the raw silk is imported from Italy and the Orient. Lyon is also a great transportation and market center.

Dijon, at the meeting of many routes, is an important manufacturer of food products, as is Nantes. Clermont-Ferrand makes rubber goods. Aubusson, in a sheep-grazing district, makes carpets, and Limoges, in a cattle-grazing region, leather goods; it also manufactures the famous Limoges china ware from near-by deposits of kaolin. Bordeaux and Marseille both manufacture food products, and the latter is the leading center for the collec-

tion and manufacture of vegetable oils in Europe, and in addition has textile, shipbuilding, and machine industries. Grasse, near the flower gardens of the Riviera, is the center for the manufacture of perfumes.

Foreign commerce. France, because of its natural self-sufficiency, is not so important in foreign commerce as are most of the neighboring countries. As in Great Britain, imports are greater than exports; they are balanced with tourist expenditures and interest on investments of capital in foreign countries. Unlike Great Britain, however, France does not import a large number of food products (Fig. 162). The total value of the trade is less than half that of Great Britain.

About a quarter of the foreign commerce is with the colonies, two thirds of this amount being with Algeria. For several years Belgium and the United Kingdom have each taken 11 per cent of the exports and supplied about 7 per cent of the imports, followed by the German Reich, which was almost as important, and then by the United States.

The long coast line on three bodies of water provides many harbors, none of which, however, is first class. Several have been improved and are the sites of some of the leading seaports of the world. The most important seaport is Marseille, which handles largely tropical and Oriental products, vegetable oils being a major product. Bordeaux is the leading wine exporting point and imports large quantities of raw products from South America. Cherbourg, a naval station, is a port of call for the large transatlantic passenger liners, and Rouen and Le Havre, the latter a major European coffee port, are the ports for Paris and handle large amounts of trade from America. Dunkirk, growing rapidly, imports much wool and other raw materials for the northeastern manufacturing district.

Although France is more important in the manufacture of heavy products than is usually supposed, nevertheless fuel is scarce and the agricultural energies are given more to the produc-

tion of food products than raw materials for manufacture. Water power, industrious people, and favorable position for conducting trade do, however, provide a basis for manufacturing. Because of freight charges, imported raw materials must be those with relatively high value; this, in conjunction with the skilled labor and hydroelectric energy that on the whole is too expensive to be applied to heavy industries, results in manufactures of superior quality and high value. The quality of the products limits competition in marketing but at the same time limits the size of the

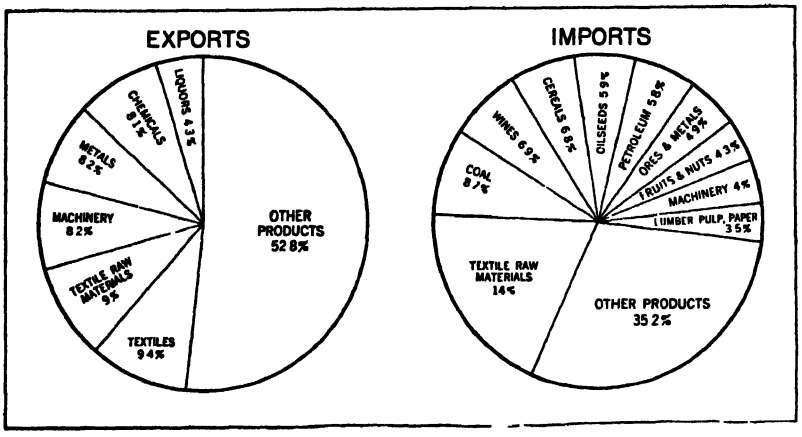


Fig. 162. Principal items in the foreign trade of France, 1936.

market and causes demand to decline rapidly in times of depression, because many of the products are luxuries, whose use can be forgone when purchasing power is low. French foreign commerce has declined seriously since 1929, both because of the depression and of economic nationalism. Unlike Great Britain, France does not have colonies with a high per capita purchasing power where they may protect markets for large quantities of trade, as the British have done with their Empire preference.

FRENCH AFRICA

Importance. The African possessions of France (Fig. 166) include 37 per cent of the total area of Africa and 22 per cent of

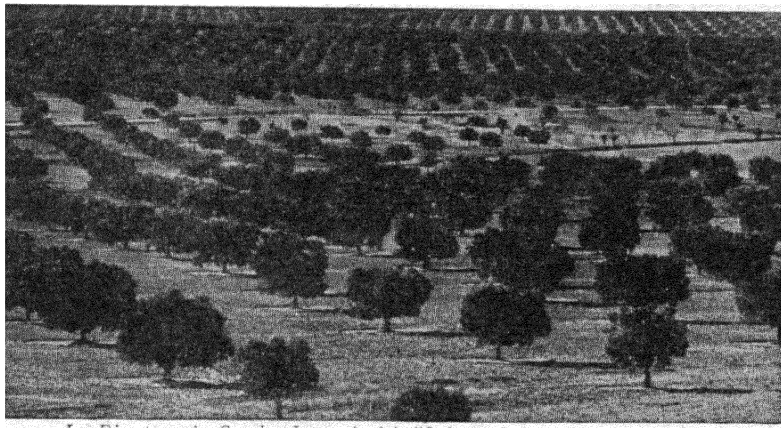
the people. Though they are more extensive than the British possessions in Africa, they contain fewer people and fewer economic resources. They are less important as sources of food and raw material, as markets, and as places for the investment of capital. They are, however, important in the commerce of the mother country, contributing 20 per cent of the total imports in 1936 and providing a market for 29 per cent of the exports. Ninety per cent of the total exports of French Africa went to France, and 60 per cent of the total imports were from there. Most valuable at present are the Atlas countries (Algeria, Morocco, and Tunis), where about one sixth of the population is European. In 1936 Algeria contributed 55 per cent of the total exports of French Africa and purchased 63 per cent of the imports; the Atlas countries together furnished 76 per cent of the exports and bought 87 per cent of the imports.

THE ATLAS COUNTRIES

Geographic features. The Atlas countries have three natural regions. The first is the Tell, a rolling coastal strip from 50 to 100 miles in width, consisting of fertile plain and of fertile river valleys extending laterally from the mountains to the south. It is the principal agricultural section, but extensive irrigation developments are necessary for its full utilization. Morocco, more exposed to the winds of the Atlantic than the others, has more rainfall, but irrigation is necessary even there. Next is the high, dry plateau of the Shotts, between the inner and the outer ranges of the Atlas Mountains, containing swamps and lakes which dry up during the dry season. The Sahara plateau, or desert, is the third region.

Minerals. Deposits of phosphate rock, salt, and coal and ores of iron, lead, zinc, cobalt, copper, tin, molybdenum, antimony, and manganese are scattered throughout this region. The French have recently found petroleum in the plateau of Algeria. One of the world's largest reserves of phosphate rock is here. It is the

leading mineral exploited and ranks first in both Tunis and Morocco. The total output recently has been 25 per cent greater than that of the United States. These reserves are important for France and for Europe in view of the dense populations to be fed and the fact that phosphorus is the scarcest of the three leading plant foods. It provides an important article of commerce for



Le Directeur du Service Intercolonial d'Information et de Documentation, Paris.

Fig. 163. Olive orchard in Tunis.

France. In Algeria iron ore is the leading mineral, followed by phosphate, while in all of the countries lead ore is third.

Fisheries. Fishing is important along the entire coast of this region; Fedhala in Morocco is one of the most important centers. The chief species are sardines, tunny, and sponges. Tunis and Morocco each has a catch about 75 per cent as valuable as that of Algeria.

Agriculture. The entire coastal fringe of these countries has the Mediterranean type of climate.[1] Agriculture is conducted largely by primitive native methods, although in Algeria 25 per cent of the agricultural land is owned by European settlers, chiefly French. The French have spent large sums on irrigation to develop agriculture.

[1] The Mediterranean type of climate is a dry subtropical climate with hot, dry summers and mild, moist winters.

The leading crops are wheat, barley, olives, and grapes. The prevailing sunlight and dry weather produce a bright barley much in demand in Europe for brewing. Grapes for wine are a major crop in Algeria, and acreage is expanding in all of the countries. Tunis is among the leaders in the production of olive oil, and in the northeastern part of that country the soil is especially adapted to citrus fruit. Various places in Algeria and the region around Casablanca have winter-vegetable industries which supply the markets of northern Europe. Silk culture is being encouraged in Algeria with a subsidy.

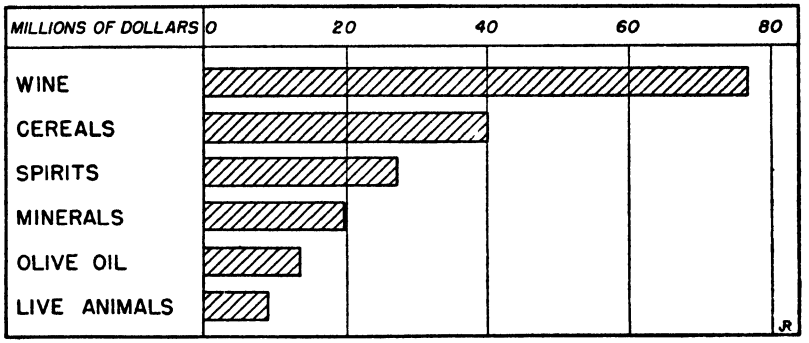


Fig. 164. Principal exports of the Atlas countries in 1935.

Alfa grass is a native crop of the plateau; it was formerly exported but is now largely consumed by a domestic paper industry.

Animal industries. The Atlas countries are fitted primarily for the herding of sheep and goats, which is the principal occupation. The raising of camels is important because of the caravan trade. The oak forests provide acorns for fattening swine, and poultry products are important in Morocco. There are 80 per cent as many animals as in France, but only 30 per cent of the animals of France are sheep and goats, compared with 80 per cent in these countries.

THE SAHARA DESERT

The Sahara, two thirds as large as Europe, is a low plateau varying in elevation from a few hundred feet to 9,000 feet, the higher

places having snow for two or three months of the year. The underlying rocks are limestone and sandstone with occasional igneous intrusions. Some parts have sand dunes, and there are many canyons, owing to the torrential nature of such rainstorms as occur, which may turn an otherwise dry water course into a raging stream.

Nomadic herding is the chief occupation of the desert, particularly on the moister margins and around the outer edges of the oases, where coarse grasses grow. Oases are found along lines of

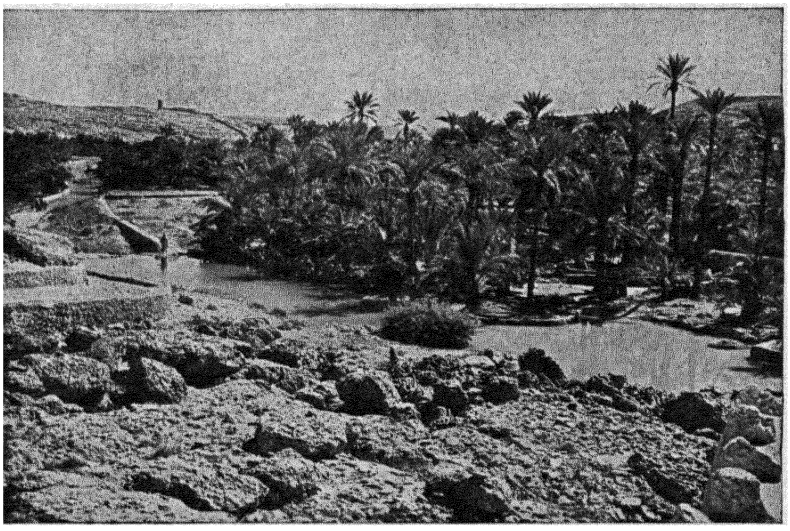


Photo by l'ofalai-Alger.

Fig. 165. An oasis in the Sahara.

depressions in the rock formations or where subterranean water reaches the surface, this water probably having its origin on mountain slopes often hundreds of miles away. Dates are the great product of the oasis and the mainstay of diet among desert peoples. In oases where the water supply is certain, other fruits, wheat, barley, and legumes are also grown. Some of the larger oases are as large or larger than some of our counties in the United States, and, except for the date trees, are somewhat similar to irrigated spots in our western dry regions. In some places in

the northern Sahara the French have sunk artesian wells, which increase the area in oases.

The Sahara is important to the French chiefly for the control which it gives of the overland routes connecting French Equatorial and French West Africa with the coasts of the Atlas countries, a valuable factor in the military defense of the mother country.

FRENCH WEST AFRICA

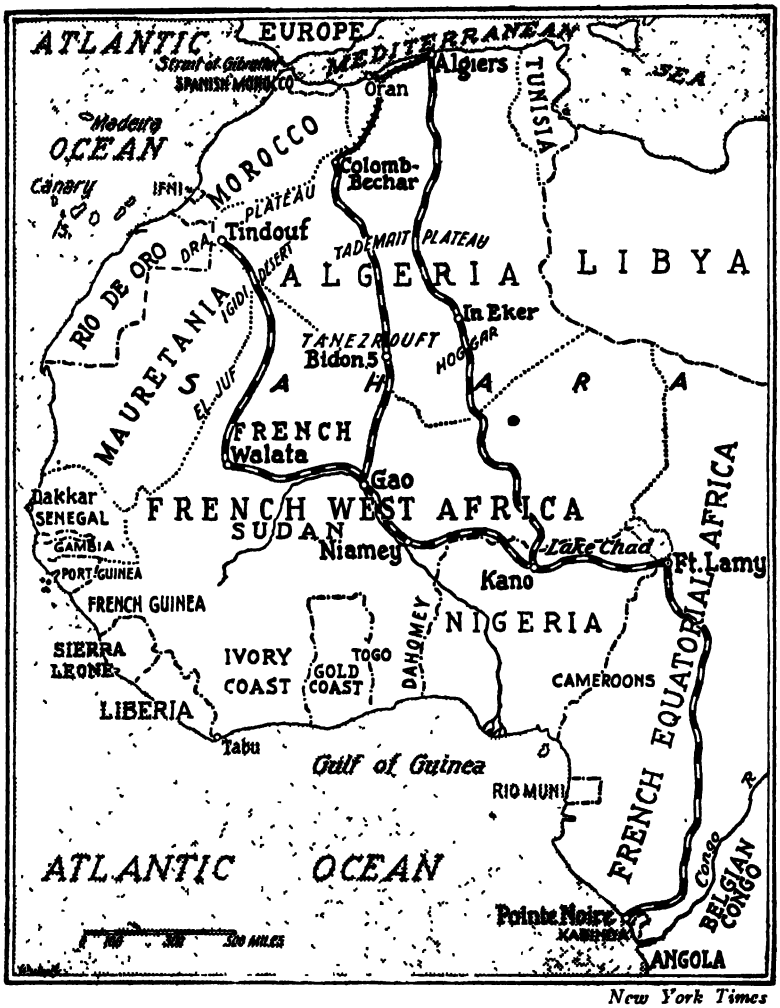
Geographic features. French West Africa is largely the Sudan type (see p. 425) of region, but it has a more varied production than the British territory to its east, because of more variation in climate and topography, better transportation, and commercial location. Throughout the Sudan three divisions may be noted: (1) the equatorial margin where tree crops predominate, (2) the middle section where cereals lead, and (3) the desert margin where only pastoral nomadism is possible, except along river valleys or where water may be obtained for irrigation. A feature of the Sudan is its flooded rivers which make irrigation possible and which lay down deposits of silt annually on their extensive flood plains.

The leading commercial crop of French West Africa is peanuts, the region contributing about half of the peanut exports of the world. Cotton is grown along the plains of the rivers, and the French are encouraging its production in the upper Niger Valley and in the Senegal Valley. Cacao, oilseeds, coffee, and gum are also exported. Cattle grazing is important, and if insects and diseases could be controlled, the region might become one of the world's leading exporters of beef.

The rivers are navigable by small steamers for considerable distances, and the French are gradually expanding the mileage of railways and motor roads (Fig. 166). Dakar is the leading seaport. Timbuktu (a fortified city) is an important caravan trading center, located on the margin between the Sudan and the Sahara.

FRENCH SOMALILAND

French Somaliland in eastern Africa is geographically similar to French West Africa. It is important chiefly because of its strategic location on the Suez route and because the only railway from Ethiopia to the sea goes through it. Hides, coffee, and ivory are its main exports. (See Fig. 156.)



New York Times

Fig. 160. Bus routes across the Sahara Desert.

FRENCH EQUATORIAL AFRICA

On account of its warm and rainy climate and its lack of transportation, French Equatorial Africa is largely undeveloped. Much of it is forested, and about 300,000 square miles have good tropical forests containing a variety of products, wild rubber being the leading one harvested at present. Others are palm oil, coffee, and cacao, and there is also ivory and small quantities of copper, lead, and zinc. The expansion of the mileage in motor roads is aiding in the development of the resources.

MADAGASCAR AND NEAR-BY ISLANDS

Madagascar, almost as large as Texas, is a tilted plateau with its long slope toward the west. Since it stands in the path of the southeast trade winds, it has a wet, tropical, heavy forested east coast; the western part is dry, with a savanna landscape. The main industry of the island is cattle raising. There are about 9,000,000 cattle and several meat-canning factories. Rice is the chief article of food, but sugar, coffee, manioc, corn, sweet potatoes, vanilla, haricot beans, and other tropical products are also grown. Tropical woods, rubber, and tanning bark are obtained from the tropical lowlands.

Several minerals are mined in Madagascar. Gold, graphite, phosphates, and mica rank in the order named. As has been stated previously, this island leads the world in the production of graphite.

SIGNIFICANCE OF POSSESSIONS TO FRANCE

Though the possessions of France in Africa are not so valuable as those of Great Britain, they are more compact and are located near the mother country. The French reap the same advantages except on a smaller scale and have the same problems as the British, although they seem to have more trouble with native uprisings than do the British. There is also the added advantage of man

power in case of war, which is very important to France, for her defense requires a strong army rather than a strong navy. For this reason France has jealously guarded the "life line" to Africa. Some of the railways across French Africa are of more strategic than economic value; at present they are not located so as to be of much importance in hauling freight.

28

THE IBERIAN PENINSULA

SPAIN and Portugal, once powers of the first rank, are not now considered among the great nations. They possess a wealth of undeveloped resources, and such development as exists is due largely to foreign capital. The scarcity of domestic capital is a serious disadvantage, and the state of political affairs in these countries has not been of a nature to attract large outside investments. Another handicap is the climate, which is too dry for the more complete realization of the agricultural possibilities without considerable expense for more irrigation facilities. The lack of water is probably the chief handicap of Spain. Rugged topography and poor soil retard agriculture in some places. Another serious obstacle is the shortage of transportation facilities, especially good roads. Furthermore, certain classes of people have never been inclined to work, and the importation of American treasure during the colonial period made it less necessary for them to work. The loss of her colonies was also a serious blow to Spain. Portugal still has some of hers, but they are of negligible importance in the economic life of the nation.

Geographic features. About 75 per cent of Iberia consists of the Meseta, a granite plateau averaging about a half mile in elevation, which has been faulted around the edges and tilted toward the west. A range of mountains divides it in the center, and it is bounded on the north by the folded Cantabrian-Pyrenees chain and on the south by the folded Sierra Nevadas, which extend into the Mediterranean as the Balearic Islands. The eastern, or bold, escarpment of the Meseta has been dissected and has a mountainous appearance. The Cantabrian and Pyrenees Mountains, one

range a continuation of the other, have their abrupt slope facing the north.

The remaining part consists of small basins and plains, the largest being that of the Guadalquivir River or Andalucia, formerly an arm of the Atlantic, between the Meseta and the Sierra Nevadas. The plain of the Ebro or Aragon is an enclosed basin, the site of a former lake or inland sea. On each side of the dividing

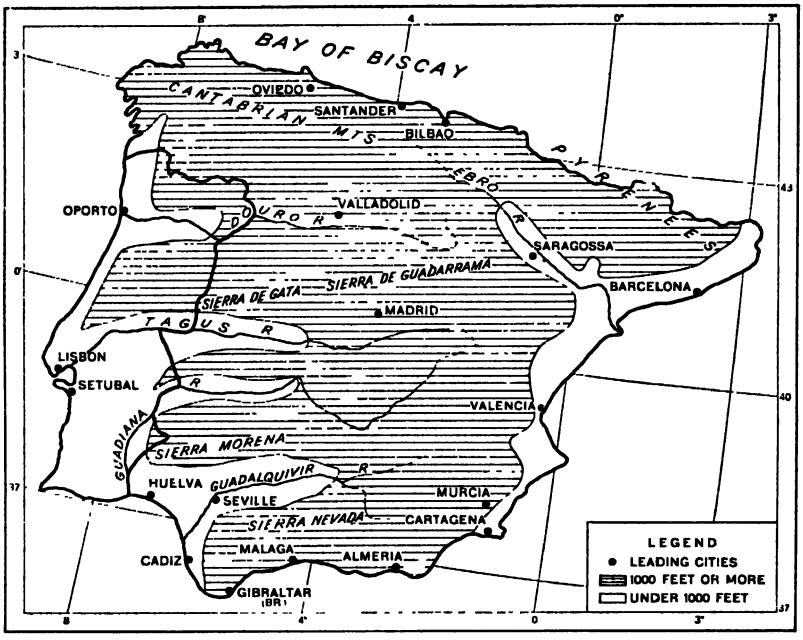


Fig. 167. The Iberian Peninsula.

range is a basin, the one drained by the Douro, the other by the Tagus, both of which also contained lakes at one time. These two basins and that of the Ebro are thus floored with alluvial materials and make good agricultural sections where there is sufficient water. The one to the north of the dividing range is the best watered of the three. Portugal is about equally divided between plain and highland. The eastern boundary is the edge of the Meseta, where the rivers fall from the highland to the lowland, although the Meseta has many spurs projecting into Portugal,

giving the country a considerable area of highland. The rivers of the Meseta, since they flow through deep gorges in reaching the sea, are unsuited for navigation, irrigation, or water power; and they are obstacles to overland transportation. The lowland area along the east coast is the richest and most productive agricultural section of Spain. It has both coastal lowland and fertile river valleys and most of the irrigated land of the country.

The topography of Iberia makes unity difficult. The routes of different regions do not converge, in contrast with France, where, in spite of the variety of surface features, the natural routes all lead to the Paris Basin. In Iberia, the regular and wall-like nature of the coast and of the Pyrenees Mountains makes penetration from the outside difficult. In addition, there is the plateau-like Meseta with its bold edges, many transverse ridges, and rivers, with falls and rapids, flowing in gorges. Madrid, the center of government in Spain, is the only large city in Iberia that is not a seaport; and history recounts that it grew as the center of government because the climate there benefited the health of an early ruler. Although the majority of the people live near the sea, the Meseta is sparsely populated considering its geographic advantages. Spain is 90 per cent as large as France and has 60 per cent as many people; Portugal is as large as Indiana and has twice the population.

Climate. Diversity of topography and exposure to prevailing winds give Iberia considerable variety in climate. On the whole, maximum rainfall is in the winter. The dry Meseta with its extremes of temperature is fit for little but sheep grazing and dryland cereals. The northwestern corner and coastlands have the oceanic type of climate which prevails in northwestern Europe, the winter temperatures being the same as in France and England, but those of summer higher. The Guadalquivir and Ebro Valleys and the coastal plain on the east and southeast all have the Mediterranean type of climate. The Guadalquivir Valley is the most Mediterranean part of the peninsula. Dry for 9 months of the year, it is so dry in summer that crops will not grow without irri-

gation. The Guadalquivir River has a uniform flow of water, however, because it is fed by snows in the mountains. The mountainous areas have heavier rainfall than the Meseta; the Cantabrians, because of their location, receive the most.

Although its southern part has the dry subtropical type of climate, Portugal faces the ocean and is better watered than Spain.

Forests. Most of the higher areas of Spain have forests, and the Cantabrians are heavily forested and a quarter of Portugal is in trees. Oak, cork oak, chestnut, and pine are the leading species. In Galicia and northern Portugal over half of the world's supply of cork is produced. Since this industry is centered there, it deserves description in some detail.

Cork oak. This tree is a broad-leaved evergreen which grows around the western half of the Mediterranean. Its bark is used for bottle stoppers, insoles for shoes, life preservers, buoys, for packing eggs and fruit, as an insulator in refrigerating equipment, for boards for interior work, and in the manufacture of linoleum. In the latter use, finely ground cork and linseed oil or other gums are mixed, spread on a layer of burlap, and sent through rollers.

The first crop of bark is inferior and is removed when the tree is about 20 years old. After that, the trees are stripped at intervals of 7 years. The removing of the bark seems to promote the growth of the tree. The best quality of bark is obtained when the tree is about 40 years of age. The tree also produces acorns, on which hogs are fattened and which give the meat a characteristic flavor.

Minerals. The Iberian Peninsula possesses important supplies of several minerals, Spain being better endowed relatively than Portugal. The deposits occur largely around the edge of the Meseta at its junction with the folded mountains. Coal normally accounts for half of the total value of minerals, and lead for 25 per cent. Spain is the leading European producer of both lead and copper, ranks second in the world for quicksilver, and is important for iron ore and phosphate, and has large reserves of bauxite which have been discovered recently.

The Cantabrian Mountains, containing largely coal and iron ore, form the leading mineral section. Two thirds of the output of coal from this section is mined near Oviedo, and iron ore is mined there and also at León, Bilbao, and Santander.

The Guadalquivir basin, producing coal and ores of copper and iron, is the second ranking district. This district usually contributes 20 to 25 per cent of the mineral output.

The Sierra Morenas are rich in minerals but are only partially exploited. Copper ore has been mined for centuries near Huelva; the same district also leads the world in pyrite and in addition mines phosphate rock. There are silver and lead ores at Linares and quicksilver at Almaden.

The minerals of the Nevadas are mainly in the hinterland of Cartagena and Almería. This district mines half as much coal as the Oviedo district and is first in lead, with one third of the output. Ores of lead and zinc are both mined near Murcia. One third of the iron ore of Spain is mined in the Nevadas, largely near Almería. Deposits of bauxite occur in various places along the coast between Barcelona and Cadiz.

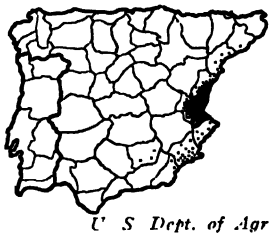
Portugal has deposits of wolframite (an important source of tungsten), pyrite, and ores of iron, copper, and arsenic, but none of them, because of the scarcity of fuel, is exploited. The most important deposits of wolframite in Europe are in central Portugal.

Water power. In spite of its general dryness, Spain has about 6 million horsepower of potential water-power energy, 20 per cent of which has been developed; it is found for the most part in the northern mountains. The potential amount is equal to that of Sweden, but, owing to the necessity for building high, expensive reservoirs to obtain a nearly uniform water supply, the cost of development is much greater in Spain.

Fisheries. Fishing is important along the northwestern coast of Iberia, particularly in Portugal, where the industry ranks next to agriculture in value of the product. The sardine, an important export, is the leading species, but there are also large quantities of tunny and cod. Setubal is the center of the industry.

Agriculture. About 88 per cent of the land of Spain and 75 per cent of that of Portugal is classed as productive, but only 40 per cent of the combined area of both is under cultivation. Both have greater opportunities in crop production and grazing; this is especially true of Portugal, with its even temperatures, abundant rainfall in many places, and fertile soil. Almost half of the land of Spain is classed as grazing and mountain land. The methods of agriculture are crude, although there recently has been some improvement in Spain.

Crops. Wheat production of the Peninsula is normally half that of France and occupies 25 per cent of the cropped land. Wheat is grown widely, but a quarter of that of Spain is from the upper Douro Valley around Valladolid, an important milling center. Barley occupies 40 per cent as much acreage as wheat and is grown widely, tending, however, to concentrate around Murcia. The crop is about half as large as that of the United States. Corn is an important crop along the more moist section of the west coast, production ranging from 25 to 30 million bushels annually. Rye, the output equal to that of corn, is grown on the poorer soils of northwest Spain and in the Douro Valley near the boundary of Portugal.

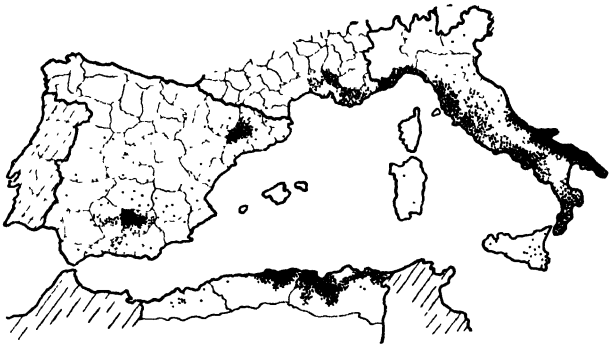


U. S. Dept. of Agr.

Fig. 168. Regions producing citrus fruit in Spain. Each dot represents 4,000 metric tons.

Tree and vine crops are relatively more important in these countries than in any other part of the world, 12 per cent of the area of Portugal and 10 per cent of Spain being in such crops. The leading citrus-fruit district of the entire Mediterranean is around Valencia, growing principally the popular Valencia orange. Spain has about 30 million orange trees and 1 million lemon trees, and, being favorably located with respect to the markets of northwest Europe, leads the world in exporting oranges, with a quantity normally 7 or 8 times as great as that of the United States. The leading center of olive production, the most typical Mediterranean

crop of all, and in which Spain also leads the world, is on the dry slopes of the upper Guadalquivir Valley. Another district is in the southern part of the province of Lérida back of Barcelona. Spain is the leading exporter of olive oil as well as of oranges, 25 per cent of the exports coming to the United States. Olive oil is an important substitute for dairy products around the entire Mediterranean, for the climate is too dry to produce sufficient forage to



U. S. Dept. of Agr.

Fig. 160. Regions of olive production in Europe and Algeria. Each dot represents 500 metric tons.

maintain a profitable dairy industry. There are large areas in almond and hazelnut trees.

Grapes—table, wine, raisin—are more widely grown than other fruits. The province of Tarragona produces a quarter of the wine of Spain. Another important district is along the Douro and other river valleys in Portugal, where the famous port wine is made and exported through Oporto. Sherry wine is made near Jerez in Spain. Because of its dry climate Malaga is the center of the raisin industry.

The Mediterranean coastal plain and connecting valleys also grow dates, bananas, sugar cane, rice, sugar beets, the mulberry, and other crops. Sugar cane and rice are grown on the swamp lands. Sugar beets are an irrigated crop. Elche is a date center and Oliva a mulberry and silk center. In the same region, large areas are planted to potatoes.

Esparto, a grass with a tough fiber, growing from three to five feet tall, is an important crop in the dry southern half of the Meseta. It is used for cordage and paper, Great Britain buying much for writing and printing paper.

Animal industries. The leading animal of Iberia is the sheep, which is grown widely but found chiefly in the drier or the more rugged sections. The greatest production is in the eastern half of Portugal and the adjacent part of Spain, and along the dividing range. In Spain sheep are kept on the mountains for summer pasturing and driven back to the lowlands and more protected places for winter. Swine are important along the Atlantic coast, being fattened on corn in the north and on acorns in the south. There are two important goat districts, one in northeastern Portugal, the other in southwestern Spain. Cattle are important only in the corn district of the northwest. The province of Salamanca produces bulls for the bull fights.

Iberia is too dry to produce sufficient forage for horses, but mules and donkeys are widespread; the United States formerly imported many jackasses from Spain for breeding purposes.

Manufactures. Although Spain and Portugal make a great variety of manufactured goods, they are not primarily manufacturing countries. The leading industries are the processing of food products—chiefly the manufacture of flour, sugar, wine, and olive oil—which is done wherever foods are grown in important amounts, and the manufacture of textiles, paper, leather goods, glass, metals, and cork products. Valladolid is the leading center of flour milling; and Zaragoza and Seville process several agricultural products.

Barcelona is the only important center of manufacturing. Seville, however, has advantages and is growing. The leadership of Barcelona is thought to result largely from the progressiveness of its people, which probably arises from the invasion of this part of Spain by people from northern Europe. Barcelona also is situated on a good harbor, is the center of a good agricultural area, and has minerals and water power near by. Cotton textiles and

paper are its leading manufactures. Raw cotton is obtained from South America, and esparto grass, from which the paper is made, is found at home.

Metal manufactures are scattered. Bilbao and Santander have blast furnaces, and Seville, Almería, and Malaga have iron-manufacturing industries. Seville also manufactures pottery, woolens and silks, tobacco, and leather goods. The city is located at the head of tidewater on the Guadalquivir in the center of important agricultural and mineral areas. The river has been dredged to take vessels of 25-foot draught, and consequently raw materials and cheap transportation facilities are both available. Valencia and Murcia have silk factories, and Malaga has a textile and a ceramics industry.

Cotton textiles are the leading manufacture of Portugal, but woolen, silk, and linen goods, and lace and embroidery are also made. Manufacturing is done chiefly in Lisbon and along the slopes of the Sa de Estrella Mountains. Porcelain tile for decorating public buildings is another manufacture, the industry being an inheritance from the Moors.

Foreign commerce. A half or more of the exports of Spain are food products, chiefly olive oil. A large part of the remainder is metals, fruits, and wine. Wine makes up one third of the exports of Portugal, with canned sardines half as important. Food products are the principal imports of both countries. Tobacco is also an important import into Spain and coal into Portugal. Much the greater share of the trade of Portugal is with the British, while about half of that of Spain is almost equally divided among the United States, the United Kingdom, and France. Oporto and Lisbon, both on good harbors, are the leading ports of Portugal; Barcelona and the ports around the Gulf of Cadiz, including Seville, are the main ones of Spain.

Atlantic islands. Spain owns most of the Canary group of islands, and Portugal owns the Madeira and Azores groups. These islands have several good harbors and are coaling stations for ships traveling the routes of this part of the Atlantic. The

Azores are also an important station in transatlantic air navigation. One of the harbors of the Canary Islands is fortified. These islands all grow the subtropical types of crops, several of which are exported, that are characteristic of the mother countries. Europeans also use these islands for winter health resorts.

SPANISH AFRICA

Divisions. Spanish Africa consists of Spanish Morocco, Ifni, Rio de Oro, and Spanish Guinea, the latter consisting of both islands and mainland with its center of government on the fertile Island of Fernando Po. The combined area of these colonies is about 129,000 square miles, and they contain a population of almost one million people. Rio de Oro contains about 90 per cent of the total area, and Spanish Morocco contains 80 per cent of the people. These colonies, although some of them have economic possibilities and others strategic value, are of almost no commercial value to the mother country. Spanish Morocco, which guards the southern side of the Straits of Gibraltar, has especial strategic value. The Tangier Zone, which is most strategically located, has been internationalized and is under the control of a commission appointed by the interested powers.

Resources and industries. Spanish Morocco grows the same types of crops and animals as Spain. Since agriculture is conducted by the natives in a primitive manner, possibilities of much greater production exist. This colony contains much known mineral wealth, and continued prospecting will probably disclose more. There is now a small output of iron and of lead in the Melilla district. The small population of Rio de Oro is nearly all engaged in fishing. Ifni also has a fishing industry, and exports dates and vegetables. Fernando Po produces cacao, and along the coast of the mainland of Spanish Guinea is some forest wealth.

PORTUGUESE AFRICA

Divisions. The African colonial possessions of Portugal are the Cape Verde Islands, Portuguese Guinea, Principe and São Thomé

Islands in the Gulf of Guinea, Angola, and Mozambique. They have a combined area of about 800,000 square miles and a population of almost 8 million. Angola contains 60 per cent of the total area and 40 per cent of the population; Mozambique has 35 per cent of the area and 52 per cent of the people. These possessions are of greater commercial importance than those of the Spanish, and some of them have strategic value, but their development has been neglected. The British have recently completed a railroad from Benguella on the coast of Angola to the Katanga mining district in Belgian Congo; here it joins another railroad with connections with Lourenço Marques on the coast of Mozambique, one of the best harbors on the east coast of Africa. More economic progress has been made in Mozambique than in Angola, because of more favorable topography and more favorable location for commerce, but the new railway through the latter will open a large territory for exploitation. The Cape Verde Islands are hot and dry and are important largely for the coaling station at São Vincente, which supplies ships engaged in the South America trade.

Resources and industries. Commercial products in Portuguese Guinea are rice, wax, palm oil, and hides. Principe and São Thomé Islands grow cacao and other tropical products. Much of Mozambique is a hot, tropical lowland, growing coconuts, groundnuts, rubber, sisal, palm nuts, cotton, and sugar cane, some of them on plantations. The lowlands of Angola have a climate like that of Mozambique and grow the same products. The interior, a plateau with a climate suited to white people, contains potential cattle-grazing land. Diamonds are obtained from alluvial deposits along the southern part of the coast of Angola, and deposits of lignite, salt, and copper ore are known to exist.

British interest in Portuguese colonies. Stronger nations have cast covetous eyes at the African possessions of Portugal—at the larger on account of their industrial raw materials and at both the large and the small because of their strategic value. The one flanks important possessions of other countries; the others are situ-

ated on important sea routes, where they might serve as naval and military bases. A political map of Africa will show that Britain should be more concerned than any other country as to who controls these colonies. The friendship of Great Britain and Portugal is traditional, but shaping events will determine the extent to which this relationship is to continue. An unfriendly power in any of the Portuguese territory, or in Portugal itself, is a threat to the British. Mozambique is important to the Union of South Africa as a source of native workers for the mines and on account of the routes from the mining districts to the port of Lourenço Marques; and Angola contains the railway which has been built to make possible the development of the great mineral resources of Northern Rhodesia and Belgian Congo. An unfriendly power in control of these routes would hinder or add greatly to the cost of the exploitation of the natural resources in the possessions of other countries.

29
ITALY

Factors in the development of Italy. The independent status of Italy is due largely to the influence of its mountain and sea frontiers. Both also affect the climate, and the Alps are a source of water power in a country deficient in mineral fuels. Because of its climate, scenery, and past history, the country has attracted tourists and has long been a center of learning.

Commercially Italy, in the center of the Mediterranean, is well placed for commerce. With no part very far from the sea, and with access to the many natural routes through the Alps to northern Europe, it obtains much transit trade and many needed imports cheaply. Before the oceans were known, it had a commanding position in commerce, but with the age of exploration and discovery, the relocation of sea routes brought about a decline. With the building of the Alpine tunnels and the Suez Canal, some trade was again attracted. If manufactures are developed, the location for marketing is good; but the countries where markets might exist have populations with low purchasing power.

For a long time before 1866 the provinces were disorganized and the country lacked unity. In that year they were united, but much was still to be desired. Since 1922, under the dictatorship of Mussolini, a unity and singleness of purpose has been developed in greater degree than ever existed before. Disunion was partially responsible for Italy's not having a part in the age of exploration and conquest, and as a result she did not obtain colonies. Although colonies have been added recently, they are only "the crumbs from the table."

A dense population (the density is about double that of France)

in a poorly endowed country creates a supply of cheap labor, which is probably the main industrial advantage possessed by the country. The lack of important colonies prevented any outlet for surplus

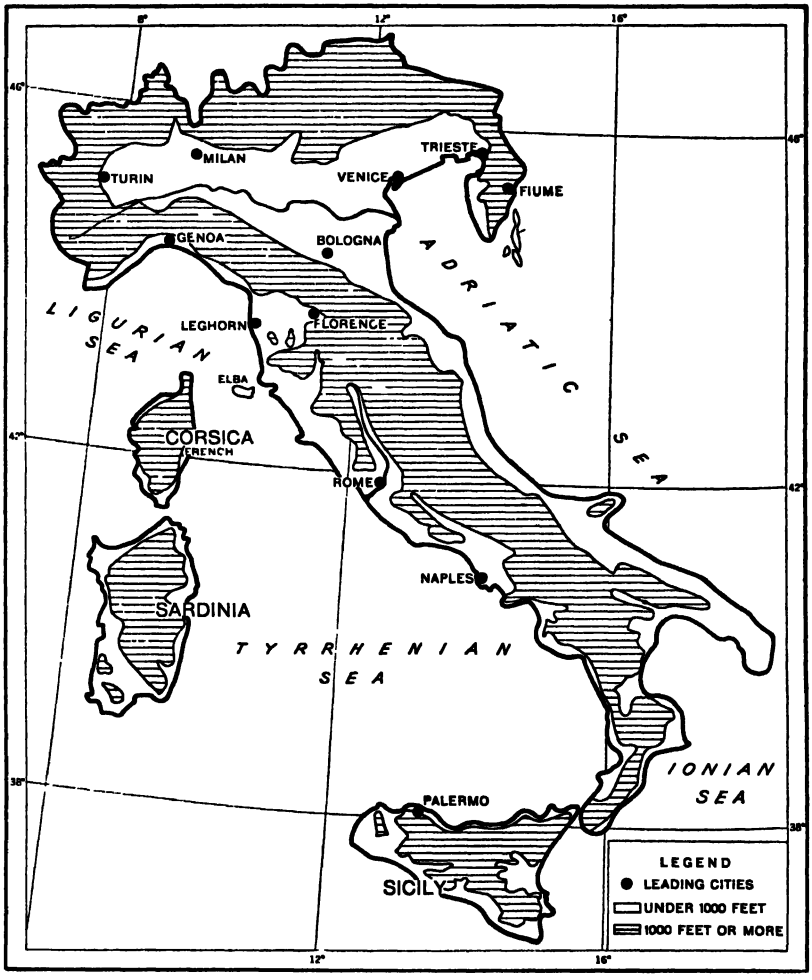


Fig. 170. Italy.

population except migration to other countries. Millions of Italians have gone to the United States and to South America. The main effect of this migration in Italy, it seems, has been to make room for replacements. Emigrants send funds back to the home

country and provide some markets for products from the mother country.

Geographic features. Italy is composed of the Alps on the north and west, the Po Valley, the peninsula (consisting largely of the Apennines flanked with a coastal plain on either side), and several islands. The Alps are important for their water power and natural routes and as a barrier against attack. They contain several glacial lakes which attract tourists and grow Mediterranean crops in their southward-facing valleys.

The Po Valley, a former arm of the Adriatic, is the heart of Italy, containing a majority of the people and most of the agriculture and manufacturing. Its location, fertile soil, and continental climate account for this importance. The types of people also are different from those in southern Italy, there being a considerable mixture with people from north of the Alps. Southern Italy, because of its poverty, has been the section from which emigrants have come.

The Apennines begin at the Altare Pass and extend through the peninsula, Sicily, and other near-by islands, and the same structure appears in Africa. The toe of the boot, northern Sicily, and the small peninsula just above the heel differ from the Apennines, for they are remnants of an old block which sank to form the Adriatic. The different structure of the old remnants compared with the Apennines accounts for the fact that the islands are better endowed with minerals. The volcanic activity of Italy occurs along the line of weakness separating the Apennines from the older blocks. The entire region of the Apennines is poor. The southern part is less barren and economically more important than the northern, which is almost uninhabited in places.

Ranking next to the Po Valley in economic importance is the broken, fertile plain extending from Spezia to beyond Naples. Large areas of malarial swamps in this plain have not only made much land useless but have sapped the energy of the people as well. These districts, now being drained and turned into pasture and crop land, are becoming prosperous sections. The coast along

the Gulf of Genoa is an extension of the French Riviera. The plain on the east side of the peninsula is less fertile than the one on the west, and the climate is less favorable for tillage agriculture.

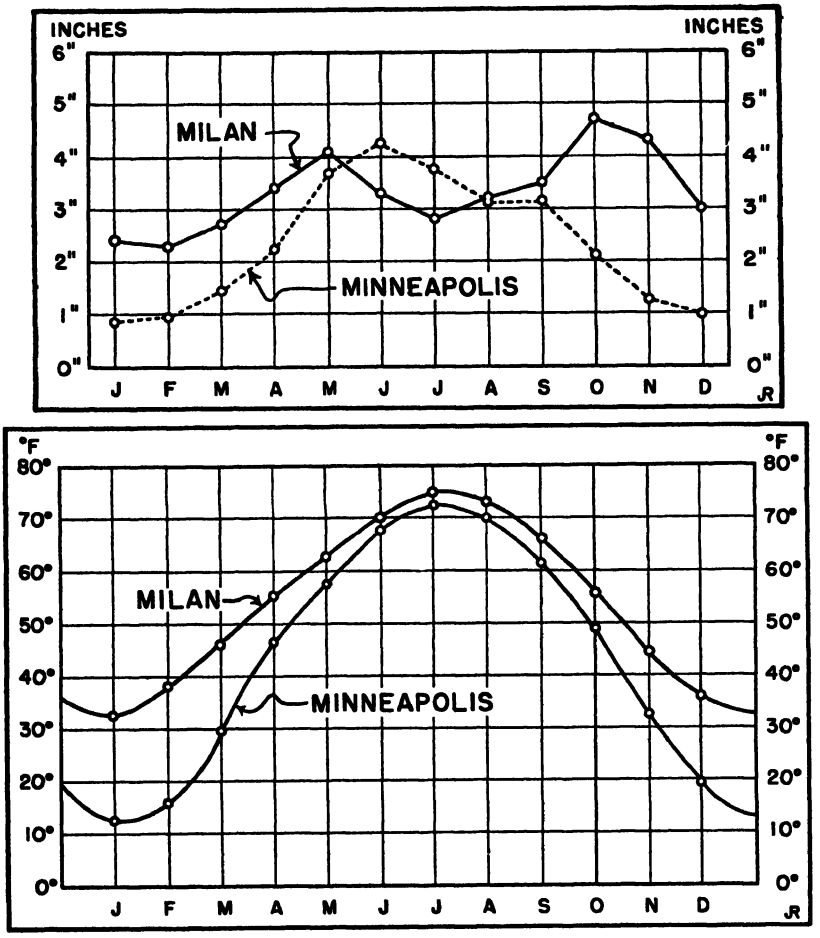


Fig. 171. Mean monthly temperatures and monthly rainfall of Milan and Minneapolis.

Sicily is a fertile island, densely peopled in most parts. Sardinia and Elba are wild and rugged and of little importance except for small supplies of minerals.

Albania, which is under the political control of Italy, is treated in Chapter 35.

Climate. The Po Valley and the Alps have a modified continental climate, the peninsula and the islands a Mediterranean climate, although it is modified in some places by position and topography. Rain falls at all seasons in the Po Valley, with a maximum in early summer and in autumn. Occasionally the temperature falls to freezing. The short winter makes possible crops with a long growing season, but not those that would be injured by frost. The foehn, a wind which blows from the mountains to the plain, is warmed by compression as it descends, and has high evaporative power. It is an influence in making possible the growing of long-season crops. Although Milan and Minneapolis are in almost exactly the same latitude, their climates differ, as Figure 171 shows, because of the difference in position with respect to other land features and water.

The northern part of the peninsula has a modified type of Mediterranean climate; southward and on the islands the true Mediterranean type prevails. Practically everywhere, however, it is more moist than on the Spanish Meseta, because of narrowness and nearness of mountains to the coast. The eastward or leeward side of the peninsula is drier in summer than the western coast and has lower winter temperatures. The latter result from the cold northeast "bora," against which the west side is protected. This wind is similar to the mistral of southern France, which is caused by high-pressure conditions to the north. The west coast has rainfall at all seasons, with a winter maximum, and the amount is greater to the north than to the south of Rome.

Minerals. Italy has deposits of several minerals, but the reserves are not large. Sulphur from the region of Mt. Etna in Sicily is the most important one, comprising about one third of the value of all minerals. The industry has declined because of competition from the Gulf coast of the United States. Iron pyrites are second, with 12 per cent of the total value, and mixed ores of lead and zinc, iron ore, and mercury each contribute about 5 per cent. Italy, at Mormet Amiata and at Idria in former Austria, leads the world in the production of mercury. Unimportant deposits of coal occur

in the central Apennines and along the base of the Alps. At Carrara, extending over an area of 80 square miles, are the largest marble quarries of the world. The marble is of the highest quality and is used widely in buildings and monuments; it has been an important factor in developing the art of sculpturing in Italy.

Agriculture. Although Italy is the leading manufacturing country of the Mediterranean, it is essentially agricultural, and probably in no other country is so large a proportion of the mountains utilized for agriculture. At present one third of the land is utilized for crops and 20 per cent for pasture and forage.

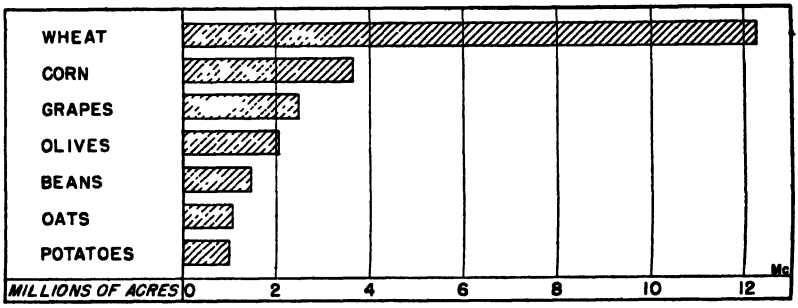


Fig. 172. Acreage of principal crops of Italy in 1935.

Crops. Cereals are grown on a quarter of the total area of the country. Wheat occupies half of the total land in crops, vine and tree crops 20 per cent, and corn 15 per cent (Fig. 172). In furtherance of the policy of self-sufficiency, attention recently has been directed away from vines, in which Italy leads all other countries in acreage, to wheat. A clarifying statement should be made here concerning the acreages of Italian crops. Because of the common practice of growing two or three crops simultaneously, a map of acreages will be misleading when compared with such a map in a country where only a single crop is grown at a time. In this case maps showing production rather than acreage are better means of comparison.

Although the fertile Po Valley is the leading agricultural section, there is a large acreage, particularly of the Mediterranean crops, along both sides of the peninsula. Normally the production of

wheat is about equal to the combined production of Kansas and North Dakota, our leading wheat states, on about 60 per cent as great an acreage. The corn crop, grown largely under irrigation, is about 100 million bushels annually. Rice is grown chiefly in the upper Po Valley, but also in the delta, where sugar beets and hemp are grown. The moisture-retaining volcanic soils near Naples grow the world's finest hemp, nearly half of the land of the district being devoted to the crop. The districts of olive culture are shown in Figure 169. Grapes are grown everywhere except in the more mountainous parts. The principal centers are around Naples and along the junction of the Po Valley with the Apennines. The Po Valley and the Naples district grow middle-latitude tree fruits, and the latter and Palermo grow citrus fruits. Sicily is the leading lemon growing and exporting district of the world.

Mulberry trees for silk culture are important in the upper Po Valley, and small amounts of raw silk are produced along the west coast and in Sicily. The industry, conducted scientifically, is fostered by both the government and private agencies. At present other crops are encroaching on the raw silk industry. Cheap labor is the most important influence in locating it, and the industrialization of the country may so increase wages that Italy cannot continue to compete with the Orient.

Animal industries. Cattle and sheep are the leading animals, the former grazing on the wet lands near the Po and on the slopes of the northern Apennines, the latter on the drier soils of the peninsula and of Sicily. The plain to the north of Rome is the area of greatest concentration. Dairying is important in the central Po Valley. Italy makes several varieties of cheese, Parmesan and Gorgonzola being two of the most famous. The poultry industry is important in the Po plain because there are local supplies of grain, and Italy is an important exporter of eggs.

Manufactures. Cheap labor, water power, commercial location, and raw silk give Italy such advantages for manufacturing as she

may possess. The Po Valley is the great center for manufactures, and this area may become even more highly industrialized than it is at present. Milan and Turin are the leading centers, but on the west coast, Naples, Leghorn, and Genoa are growing. The east coast is more barren than the west, lacks good harbors, and is not located well with respect to the flow of commerce, and consequently has but little manufacturing and no important cities.

The manufacture of textiles, all types being represented, is the most important industry. Milan stands first in both cotton and silk, ranking ahead of Lyon and next to Paterson, New Jersey, in the latter. Italy has about the same number of cotton spindles as North Carolina. Biella is the principal city for woolens. Italy is first in Europe and next to the United States as a producer of rayon, which is used extensively there for mixing with silk.

The manufacture of iron and steel and related products is the second-ranking industry. Milan is the leading city, being especially noted for railway equipment and supplies. Turin manufactures automobiles, and the Genoa-Savona area, Venice, Trieste, and Palermo all have shipbuilding industries. Though Italy has several small deposits of iron ore, the importance of scrap iron and scrap steel as sources of raw material is well worth noting. Since iron may be reclaimed in large quantities, it is possible for countries with the other requirements for manufacturing iron and steel to develop in this industry. Italy stands next to Japan as an importer of scrap. Recently it obtained a large quantity when the railway gauges of Argentina were unified. It may be added that since scrap does not have to be smelted, the fuel problem is somewhat different from that of places where iron ore must be smelted before steel can be made.

Leghorn and Naples are manufacturing centers of recent development. The municipality of Naples furnishes free sites and water power for industries which locate there. It is the largest city and seaport of Italy and has a good harbor. It has motor works and processes various food products, importing coal for a

portion of the necessary power. Leghorn has glass, copper, engineering, and lace industries, and makes macaroni from a special kind of wheat which grows near by.

Foreign commerce. The principal exports and imports of Italy are given in Figure 173. Foods were at one time more important than now; the campaign to make Italian agriculture more productive and the nation more self-sufficient in food has evidently borne fruit. The countries which share most in this trade are the Ger-

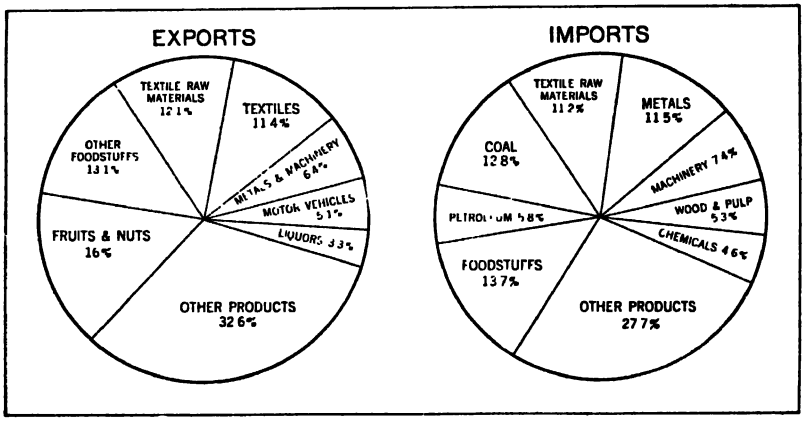


Fig. 173 Principal items in the foreign commerce of Italy in 1936.

man Reich, the United Kingdom, and the United States, the first being about twice as important as either of the other two.

Usually Italy has an unfavorable balance of trade; emigrant remittances and tourist expenditures largely balance it.

Genoa handles about one third of the total foreign commerce, Venice about 17 per cent, and Trieste, Naples, and Leghorn each about 8 per cent.

ITALIAN AFRICA

Divisions. Italian possessions in Africa are Libya and Italian East Africa (Eritrea, Italian Somaliland, and Ethiopia). Their combined area is ten times that of the mother country, but the combined population is only 20 per cent as great. Italy has hopes that her surplus population may be settled in these colonies. Un-

less developments in Ethiopia are different from what has been experienced in the other African possessions, little will be realized. While proof as to the actual extent is still lacking, Ethiopia does contain more natural wealth in minerals and agricultural possibilities than the others; and the home government is taking a more active part in the development of these resources than it has in any of the other colonies. The climate, however, is much different from that of Italy, and it remains to be seen whether colonists can live there. Furthermore, millions of dollars will be required to build highways, railways, and irrigation facilities and to provide for exploiting the minerals. Since Italy is not a wealthy country, foreign loans will be necessary for the purpose.

Libya. In Libya, which is nearly all desert, three divisions may be recognized: a small strip of about 17,000 square miles along the coast, which has a Mediterranean climate, the subdesert, and the desert. The coastal strip contains some of the richest oases of northern Africa; the various Mediterranean fruits, tobacco, wheat, and barley are grown in them. Some of the sand dunes are being forested, and while now only nomadic herding prevails, it is claimed that Cyrenaica could graze cattle on a large scale. The subdesert grows alfa grass, which is used for making paper, and has some salt.

Along the coast are sponge and tunny fisheries. Because of its indentations, the coast has always been important as a headquarters for caravan routes, but these have declined with the extension of rail and motor transportation into the middle of Africa.

Eritrea and Italian Somaliland. Like the possessions of other countries along the Red Sea route, these two countries have probably been of more strategic than economic importance. They help to give control over sea routes and provide a base from which to penetrate into the interior. On the whole these colonies are too dry for agriculture, and pastoral nomadism prevails, but there are several fertile spots now being developed with irrigation, and there are several thousand acres in plantations under Italian ownership in Somaliland. Small supplies of gold and salt are mined

in Eritrea, and small quantities of various animal products, vegetable oils, gums, cotton, ivory, and other tropical products are exported.

Ethiopia. This country is a highly dissected plateau of sheets of volcanic rocks. The rivers flow in deep gorges, making transportation difficult. There are agricultural opportunities, if irrigation is provided, on the southern side of the highlands, but much of the water that might be used for this purpose is on the northern side of the mountains in the upper reaches of the Blue Nile. Grazing is now the leading occupation, and cattle, sheep, and goats are numerous. A horse is produced which makes a good polo pony. Coffee is the leading crop, the plant getting its name from the province of Kaffa, its native home. There are large areas of wild coffee trees. Other tropical and subtropical crops are grown, and foreign companies are experimenting with cotton. There are potash deposits in the Asal plain, which are being mined by the Italians. It is thought that there may be supplies of other minerals, among which is petroleum.

Hides and skins and coffee are the leading exports. Exports move out partly by caravan, but chiefly over the railway which goes across French Somaliland.

Significance of colonies. To date the colonies of Italy have cost enormously more than has been received in return from them; and, although Ethiopia does seem to possess much greater natural wealth than the others, this condition of affairs promises to continue for some time. Thus far Italy seems to have gained only prestige of a sort by her acquisition of territory. However, one advantage of the colonies is their strategic location with respect to wealthier colonies of other nations. In case Ethiopia is finally able to supply large quantities of raw materials, these can be taken to Italy to be manufactured, giving added employment there to capital and labor and a higher standard of living for the nation. Ethiopia has a large native population which should provide a market of considerable volume for Italian manufactures.

In addition to the lack of capital for development and the trop-

ical heat, other problems which must be faced in exploiting these colonies are the lack of water for irrigating any considerable portion of the desert, the heavy rains which damage highways and railways, and the expense of controlling a native population that is likely for some time to be unfriendly

30

THE THREE SMALL EMPIRE COUNTRIES OF NORTHWESTERN EUROPE

Common features. Belgium, the Netherlands, and Denmark are here treated together because all are low contiguous countries of northwestern Europe, all have extensive foreign colonies, and all have their greatest economic interests with their adjacent powerful neighbors, Germany, France, and England.

Location that gives control of important trade routes has been of utmost significance in their history. At one time Denmark was the leading power of the Baltic region, controlling its commerce, and not until 1857 did the levying of tolls on all vessels passing Copenhagen cease. That city is still the leading entrepôt of the Baltic area. The other two countries both collect and reëxport products from their colonies and have much *transit trade*—trade destined for some other country but which must pass through one of these two countries. The Netherlands has a greater volume than Belgium, because it controls the mouths of the Rhine and the Schelde Rivers.

Area and population. These three countries have a combined area about equal to that of Ohio but have three times as many people. Their combined population is about 80 per cent that of Spain, which is almost five times as large. The density of population is 706 per square mile in Belgium, 629 in the Netherlands, and 224 in Denmark.

The people of Denmark and the majority of those of the Netherlands and the northern half of Belgium are Teutonic; those of the remainder of Belgium are similar to the French. The two groups of Belgians are, however, united by a common religion.

BELGIUM

Geographic features. Belgium is located where the central plain of Europe is narrowest, making the country a focal point throughout history for armies passing east and west through Europe. Its physical features are extensions of those of neighboring

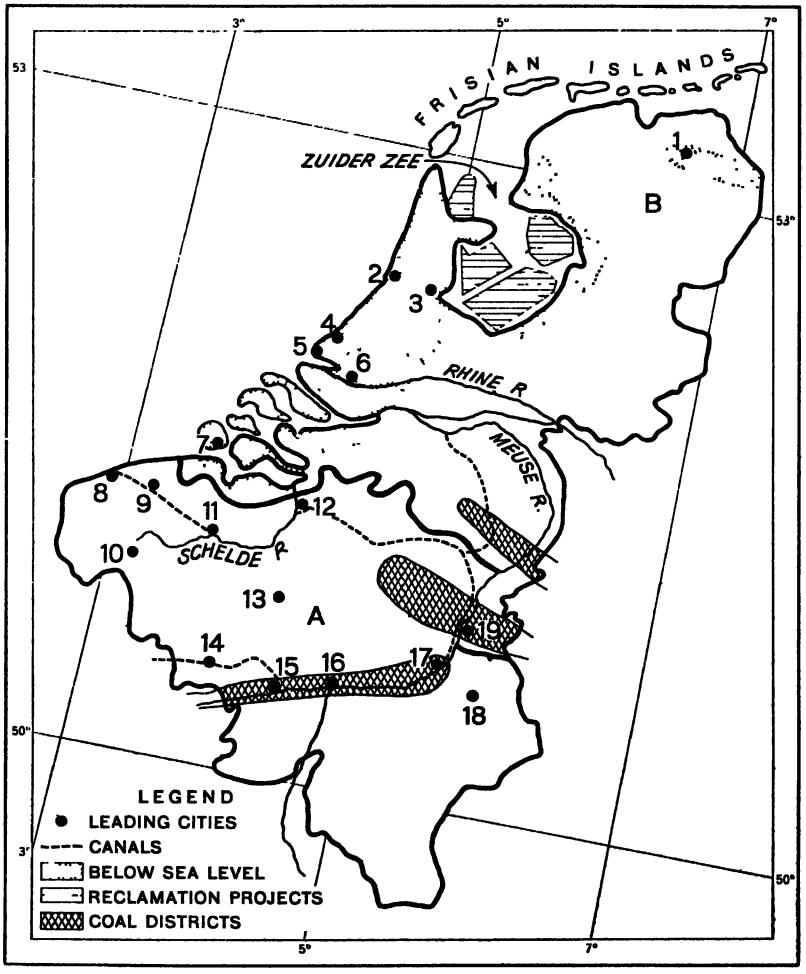


Fig. 174. A—Belgium; B—The Netherlands. (1) Groningen, (2) Haarlem, (3) Amsterdam, (4) The Hague, (5) Hook of Holland, (6) Rotterdam, (7) Flushing, (8) Ostend, (9) Bruges, (10) Courtrai, (11) Ghent, (12) Antwerp, (13) Brussels, (14) Mons, (15) Charleroi, (16) Namur, (17) Liege, (18) Verviers, (19) Maastricht. Only important commercial canals of Belgium are shown.

countries. Three divisions of the country may be recognized: a narrow coastal strip of dunes and land below sea level, part of a larger similar area in the Netherlands, which, owing to poor drainage, is used for grazing; the rolling central plain which has a highly developed agriculture; and the rugged Ardennes plateau in the south, which, on account of poor soil and a severe climate, is fit for little but forests and sheep grazing. It is at the junction of the Ardennes plateau and the plain that the leading natural route between east and west Europe is located. It has several branches which turn off into river valleys on the south.

Minerals. Coal is the only mineral wealth of importance in Belgium. The reserves are estimated at 11 billion tons, half of which is good coking coal. They are sufficient to last the nation for several centuries. The deposits are along the junction of the Ardennes plateau and the plain, and in the Campine, the latter area containing the best coal and 75 per cent of the reserves. Because of folded and thin seams and their depth underground, mining is difficult and expensive and the output per worker is one of the lowest in Europe.

Large quantities of minerals are imported for smelting and for manufacture.

Agriculture. A little more than half of the total area of the country is under cultivation, 45 per cent of the cultivated area being in pasture and hay, 33 per cent in cereals, chiefly oats, rye, and wheat, and 15 per cent in root crops, potatoes, beets for forage, and sugar beets all being important. An excellent quality of flax is grown in the northwest. The raising of swine and cattle (50 per cent being dairy animals) is important.

The agriculture is largely of the garden type, with high yields, because of small holdings and intensive methods; the holdings do not average more than four or five acres. The factory workers live mainly on small farms, the women and children doing much of the farm work.

Manufactures. Coal, cheap and industrious labor, favorable location for trade, and cheap inland water transportation make Bel-

gium primarily a manufacturing country, 78 per cent of the people being urban. The heavy industries and the manufacture of textiles of superior quality are both important. The principal center is in the coal fields, where the manufacture of iron and steel and other metal products, cement and brick, glass and chemicals is carried on, at Liege, Namur, and Charleroi. Good pottery is made at Mons. Liege is one of the leading manufacturers of firearms in the world.

Belgium has long been famous for textiles of high quality, particularly those made by hand. Ghent is the center for cotton and linen manufacture, and Verviers, where the alkali water of the river is used for washing wool, for woolens. Bruges and Brussels are centers for handmade lace, and the latter for rugs and carpets as well.

Cement and plate glass are important exports, both coming to the United States and competing with the domestic product when we do not exclude them with a tariff. Much cement, exported as ballast in ships, moves cheaply. The manufacture of margarine uses a colonial product to supply a cheap butter substitute to a thrifty people. Fertilizer is important to the intensive type of agriculture which prevails. Diamond cutting is important in Antwerp, and diamonds are an important export.

Foreign commerce. Raw materials comprise about half of the imports of Belgium, manufactures 25 per cent, and foods 20 per cent. Half of the exports are manufactured goods, iron and steel leading, followed by textiles and glass, and a third are raw materials, some of them colonial products. France usually provides the market for nearly a fifth of the exports and is the source of a seventh of the imports, followed by the United Kingdom, the German Reich, and the Netherlands, each roughly of equal importance, and then the United States.

Antwerp, with a 35-foot channel at high tide, is one of the world's leading seaports and has industries for processing many of the products assembled there. The Belgians have spent large amounts of money to make it one of the most modern of seaports.

Antwerp handles the bulk of the transit trade which ultimately goes to Germany and other parts of central Europe by rail, the Rhine ports of Holland being more important for the transit trade that moves by water. Some products are able to bear the higher rail cost; others, like cotton or wool, are likely to be damaged when transported on internal waterways.

BELGIAN INTERESTS IN AFRICA

Geographic features. The Belgian Congo, 80 times the size of the mother country and with only a slightly larger population, consists largely of the basin of the Congo River, a circular, saucer-shaped plateau surrounded by higher plateaus. It is thought to have been the location of a large inland body of water at one time. The region is largely forested, and the climate is similar to that of the region around the Gulf of Guinea. Because of the great amount of poorly drained soil which provides breeding places for the tsetse fly, sleeping sickness is more prevalent in the Belgian Congo than in any other part of Africa. Though the rivers contain many falls, which are a serious obstacle to transportation, there are long stretches of navigable water between some of the falls.

Products. The principal crops of Belgian Congo are the oil palm, cotton, and rice; others are rubber, cacao, and tobacco. The grazing of cattle is important in the high plateaus of the former German territory in the southeast. This is one of the most important cattle districts of Africa and there is still much unused land. Rice is an important food crop of the natives. Attempts are being made to expand cotton growing, which now supplies an important part of the requirements of the home country. Ivory and copal, a fossilized, resinous substance from a tree, used in making varnish, are of minor importance.

Minerals are the leading group of products. The most important of these is usually copper from the Katanga section, this region, as has previously been stated, now being connected with both the east and the west coast of Africa by rail. It was the building of the railway through Angola which made Katanga a com-

petitor in the world market for copper, making both the rail and the ocean haul to market shorter. The reserves of copper have been estimated at 40,000,000 tons, and the purity of the ore is three times the average for the United States. Production has averaged about half that of Chile for about a decade, and the trend is distinctly upward. Gold-, tin-, and radium-bearing ores are also mined in the Katanga district, and gold is mined at Kilo-Moto, and diamonds in the Kasai section.

Transportation. Inland transportation is mostly by river. Other means are expanding slowly. There are a few railways, and Leopoldville is connected with other important cities by air lines. A motor road connects Rejaf and Stanleyville, the latter being the terminus of river navigation from Leopoldville. A motor road also connects Rejaf and Khartoum, as was previously stated. Between Matidi and Leopoldville is a pipe line to transport oil for fuel for the river steamers.

Foreign commerce. About 75 per cent of the exports, consisting largely of minerals, of Belgian Congo go to Belgium, and half of the imports are from there, the leading imports being food products, cotton textiles, machinery, and petroleum. One per cent of the total exports of Belgium goes to Belgian Congo; eight per cent of the Belgian imports are from there. Matidi is the leading seaport.

THE NETHERLANDS

Geographic features. Sixty per cent of the Netherlands consists of a low, poorly drained plain which is largely the combined deltas of the rivers which flow through it to the sea. The remaining portion—the northeast—is higher and better drained, but has leached glacial soil. A quarter of the total area is below sea level, this land extending from the Zuider Zee into Belgium. Sand dunes pile up along the coast, shutting out the sea, and dykes are built to aid this process. Continued pumping to draw off the water makes it possible to use such land for agriculture. Much of the land above sea level must also be artifically drained. To

control the drainage, dykes must be built along the main rivers as well as along the sea. The steadiness of the winds has always made it possible to do much pumping with windmills, but recently a considerable amount has been done with internal-combustion and electric motors. The water must be raised from one level to another until it reaches a stream going to the sea. Polders, the small areas surrounded by dykes from which the water is pumped, are a common feature of the country. An extensive program to reclaim a large part of the Zuider Zee, which was formed by a severe storm that broke through the dykes in the thirteenth century, is now being gradually completed. This will add fertile soil valued at more than 200 million dollars.

Minerals. One would not expect the occurrence of many minerals in a country with the geological history of the Netherlands. Coal, recently discovered in Limburg, and pottery clays at Delft and the Hague are the only ones. The coal deposits were not worked much before the World War, but since then, with the state owning and operating the majority of the mines, production has increased rapidly and has been from 40 to 50 per cent as great as that of Belgium for several years. The state mine at Lutterade is one of the most modernly equipped mines in Europe. The industry is somewhat impeded at present because the coal must be hauled by rail to Maastricht before it can move by water. This limits its ability to compete with other coals. The lack of domestic supplies in the past has not been a serious handicap because the location of the country has made it easy to obtain foreign supplies.

Agriculture. The Netherlands is primarily an agricultural country. Seventy per cent of the total area is under cultivation, 55 per cent of the cultivated land being in pasture and hay, 20 per cent in cereals, 10 per cent in root crops, and the remainder mostly in horticultural products. The growing of flower bulbs, much of it under glass, is important. The center of the bulb industry is Haarlem, in a district having both sand and clay soils.

Rye, oats, and potatoes grow on the poor soils of the south and the east, wheat on the more fertile ones of the west. Dairying, the leading industry, is more important on the moist clay soils of the west, but Groningen in the northeast is the center of a butter-producing area. Sheep, however, are more important on the glacial soils than are cattle. Swine and poultry are also kept, bacon and eggs being exported.

Along the coast and especially in the districts where the land has been reclaimed from the sea, large estates prevail, but in the remaining part the farms are in small holdings.

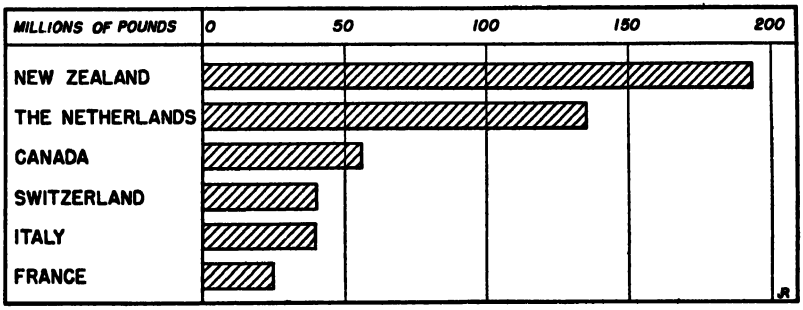


Fig. 175. Principal cheese-exporting countries in 1935.

Manufactures. About half of the population of the Netherlands is classed as urban, probably on account of the importance of commerce and fishing, for the country is not important in manufacturing. When manufactures were first rising in Europe, the Netherlands was important, but that was in the days of hand methods, when the leading types were those requiring relatively little power. At present the leading industries are the manufacture of dairy products and margarine, the latter from vegetable oils from the colonies. The dairy products, of superior quality, command a high price in world markets. Instead of using much butter themselves, the people export it and buy cheap substitutes. Liquors, sugar, cocoa, flour, and tobacco are other manufactures. Amsterdam manufactures tobacco and leads the world in diamond cutting, a tedious type of work requiring much skill. This indus-

try is a heritage of the days when the Netherlands held the diamond-producing country in southern Africa. Recently, however, diamond grinding has been declining with the migration of many of the workers to Africa and the rise of this industry in Brooklyn in the United States. There is a considerable amount of textile manufacturing, the major part being in the province of Overijssel. A distinctive type of pottery is made also.

Foreign commerce. The Netherlands has long been important in commerce, carrying the commodities of other countries in her ships and conducting an entrepôt trade in colonial produce. The leading exports are dairy products (the Netherlands is second in exporting cheese and first in evaporated and condensed milk), textiles, coal, tin from the colonies, and iron and steel. The principal imports are textiles, raw cotton, cereals, iron and steel, lumber, and oilseeds. The German Reich takes first place in the foreign trade; recently furnishing 25 per cent of the imports and taking 15 per cent of the exports, and is followed by the United Kingdom with 10 per cent of the imports and 21 per cent of the exports and then Belgium with about 12 per cent of each.

Rotterdam is one of the most modern of seaports and, like Antwerp, has a 35-foot channel at high tide. It handles chiefly bulky products for the manufacturing areas of central Europe but also exports great quantities of goods for the same region. Its outport has considerable traffic, especially passenger traffic. One should note that the majority of the North Sea and Baltic ports are located inland. This fact results in the growth of outports for several of them. The Hook is the outport for Rotterdam and Flushing the outport for Antwerp. Rotterdam has 50 per cent more tonnage than Antwerp.

Amsterdam is of much less importance than either Rotterdam or Antwerp. It handles chiefly tropical products, cotton, wool, and petroleum.

The Netherlands colonial possessions. Although it seems more logical to discuss the colonial possessions of the Netherlands with the continent in which they occur, namely Asia, it should be stated

here that these possessions, called Netherland India, comprise the most important tropical empire of any country. They provide a place where surplus capital of the mother country may be invested,



Fig. 176. Denmark, the Island of Bornholm in inset.

and products for her ships to haul and for her merchants and businessmen to sell.

DENMARK

Geographic features. With the exception of the island of Bornholm, Denmark is only an extension of the low glacial plain of Germany. Bornholm is a disconnected part of the Scandinavian

highlands, and, being composed of hard rock, it is rugged. Denmark lacks important natural resources other than soil. Much of the soil originally was poor and has been brought to its present high state of productivity only by hard work and the application of scientific methods. Some of it is still almost useless, the worst being along the west coast of the peninsula, where sand dunes have been formed by the winds. Trees have been planted to pre-

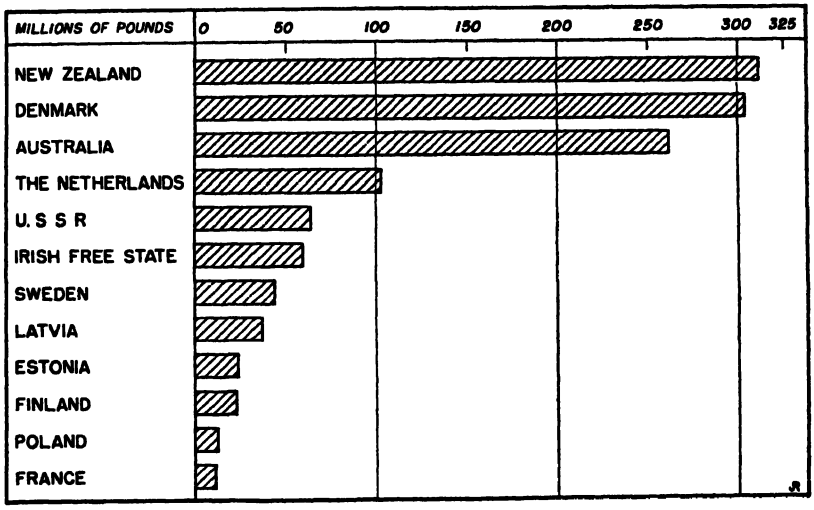


Fig. 177. Principal butter-exporting countries in 1935.

vent the spread of the dunes. The eastern side of the peninsula and the islands have a more fertile soil.

There are both coastal and deep-water fisheries, which have been growing in commercial importance during the past few decades with the development of improved and quicker methods of marketing and transportation.

Agriculture. The cool climate, high humidity, and poor soil combine to make Denmark a grass-growing and therefore a dairying country. Three fourths of the entire area is under cultivation, 40 per cent of the cultivated area being in pasture and hay, a like amount in cereals, oats and barley leading, and 17 per cent in root crops for both food and forage. Denmark is almost self-

sufficient in sugar. The yields are among the highest in the world (see p. 506). In addition to dairying, the raising of swine and poultry is important, these industries being adjuncts to the dairying industry.

Under normal conditions Danish agriculture is prosperous because of coöperative effort, which has succeeded because of the high standard of technical education that prevails among the rural people. The government fosters and encourages the entire program. Small holdings now prevail, but at one time Denmark was a nation of large estates, whose division was one of the first accomplishments in the building of the present agricultural system. A law prohibits the merging of small holdings under one ownership and protects the interests of tenants so long as they manage efficiently.

Manufactures. The manufactures of Denmark are similar to those of the Netherlands, being concerned primarily with processing the various agricultural products that are grown. The preparation of dairy products and meats, the refining of sugar, and the manufacture of liquors are the more important ones. Some cement is made in northern Jutland; the manufacture of paper is increasing; and agricultural machinery and margarine are other products. Bornholm has deposits of clay which are made into pottery in Copenhagen.

Foreign commerce. In spite of the high rank of agriculture, foreign commerce is still an important activity in Denmark, as is shown by the fact that 20 per cent of the people live in Copenhagen, which has the best harbor and is the largest seaport of the country. The building of the Kiel Canal was a severe blow to the trade of Copenhagen. But the natural route is the safest; and the Danes, in order to compete with the canal, organized their transportation so that through train and ferry service could be provided between the mainland and the islands and with Sweden. More recently they have enlarged the free port facilities of Copenhagen. Copenhagen is an important collecting and distributing center for the entire Baltic area, being especially important in the assembling

of dairy products from the countries around the eastern end of the sea.

The leading exports are bacon, butter, and eggs. Denmark holds second place in butter exports and ranks second among the nations in exports of bacon and eggs. Iron and steel and coal are the most important imports, followed by oilcake, textiles, lumber, fertilizer, and wheat.

The United Kingdom has recently been the market for 57 per cent of Danish exports and has supplied 40 per cent of the imports, followed by the German Reich, with 20 per cent of the exports and 25 per cent of the imports, and Sweden with 7 per cent of each.

GREENLAND AND ICELAND

Greenland. Greenland, the only colony of Denmark, is a fourth as large as the United States, but has only 17,000 people, most of whom are Eskimos. It is elevated and almost entirely covered with an icecap which is one source of the icebergs which cause trouble for North Atlantic shipping during the early summer months. Only a narrow coastal fringe is not under ice. The only important resource at present is cryolite, a mineral which is used in manufacturing aluminum, opaque glass, and insecticides. The world's largest deposit of this mineral occurs at Ivigtut, the only place where it is now mined. It is exported chiefly to Copenhagen. Other exports are fish, furs, and graphite. The foreign trade is a state monopoly of Denmark.

Iceland. Iceland is united with Denmark only to the extent that they have a common king. The island is about the size of Kentucky but has only half as many people as the City of Louisville. Volcanic in origin, it has many geysers and hot springs and a range of mountains, which, with the Atlantic Drift, temper the south coast and make it much warmer than is warranted by its latitude.

The raising of sheep is the leading occupation, the industry providing 80 per cent of the exports. Only about 65,000 acres are under cultivation, potatoes, turnips, and hay being the leading

crops. About 40 per cent of the people are classed as agricultural. Fishing is important, the cod providing over 80 per cent of the catch, and fish are important for food and for export.

The leading imports are textiles, vehicles, metal products, foods, coal, and timber, the types and variety reflecting the high state of progress which prevails. Great Britain provides about 30 per cent of the imports and Denmark 25 per cent. The exports are more evenly distributed, Portugal, Spain, Great Britain, Italy, Germany, and Norway all ranking high. The Mediterranean countries are an important market for fish. The imports and exports are usually evenly balanced.

ECONOMIC NATIONALISM AND THE SMALL EMPIRE COUNTRIES

Because of the dependence of small empire countries on foreign markets, the growth of economic nationalism is a serious menace to their economic welfare. Years of painstaking endeavor have gone into the development of products which compete in world markets on the basis of quality. Great Britain has its Empire preference, and several parts of the Empire compete in the same products which Denmark and the Netherlands export in greatest quantity. In addition, Great Britain is attempting to rehabilitate the domestic production of these same products, even placing quota restrictions on their importation from her own possessions. The policy of autarchy in Germany is much more extreme, its intention being the freeing of Germany as completely as possible from dependence on foreign sources of commodities.

31

THE SCANDINAVIAN PENINSULA

THE Scandinavian Peninsula contains much land that is made inhospitable by barrenness, ruggedness, or coldness, and lacks balance in its natural resources. Nevertheless, it is a land of accomplishment, and its people are among the most progressive in the world. While the natural resources lack balance, abundant supplies of water power and forest products and productive fisheries do exist; these, together with a good location for conducting foreign trade and an invigorating climate which has made a hardy, industrious people, have been the basis of economic progress.

This peninsula is divided between two nations, separated in most places at the water parting of the mountains which extend lengthwise through it. One nation, Norway, faces the Atlantic and is similar in some features to other North Sea countries; the other, Sweden, faces eastward and partakes more of the features of central Europe. The combined area of the two countries is about half that of Alaska, and together they have about 9 million people. Sweden is 30 per cent larger than Norway and has double the population. Norway, the same size as Italy, has only 7 per cent as many people as Italy, an interesting contrast between a northern and a subtropical country, neither of which is richly endowed with natural resources.

Geographic features. The Scandinavian Peninsula is largely a high plateau of ancient rocks, bold on the west and sloping more gently toward the Baltic, and higher in the south than in the north. Only in Scania, in southern Sweden, do young rock formations occur. The entire region has been glaciated. Lowland areas have been covered with glacial material, and there are much

barren territory and numerous lakes and deep, narrow river valleys. The *skerry guard* of protecting islands and the *fiords* are features of the coast of Norway, which is 12,000 miles in length.

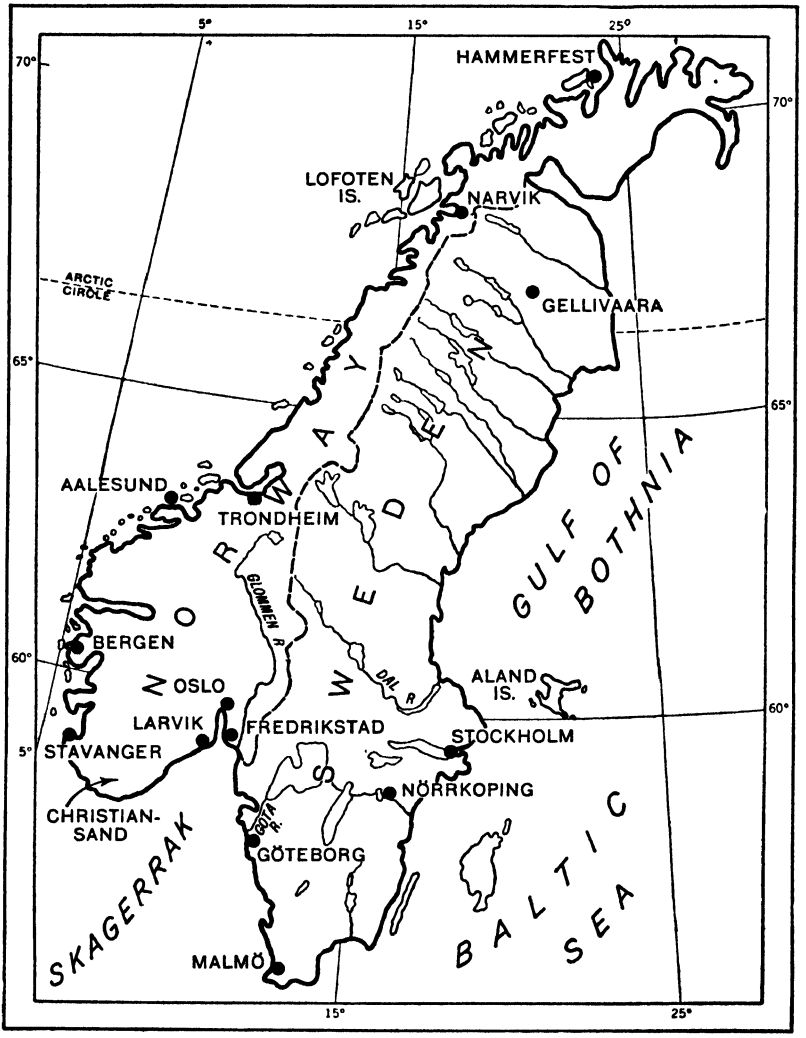


Fig. 178. The Scandinavian Peninsula.

Climate. The climate of this region is cool and moist, with many cloudy days. Norway, exposed to the ocean winds, has more moderate temperatures and heavier rainfall than Sweden,

which is affected more by continental influences. The westerly winds and the conditions of atmospheric pressure are the major controls of the climate. Owing to the winds from the ocean and the North Atlantic Drift, the seaports of Norway, even on the north, are free of ice the year round, while those of Sweden are usually frozen for several months. Figure 179 contrasts the temperatures of Bergen with those of Stockholm. Rainfall at the

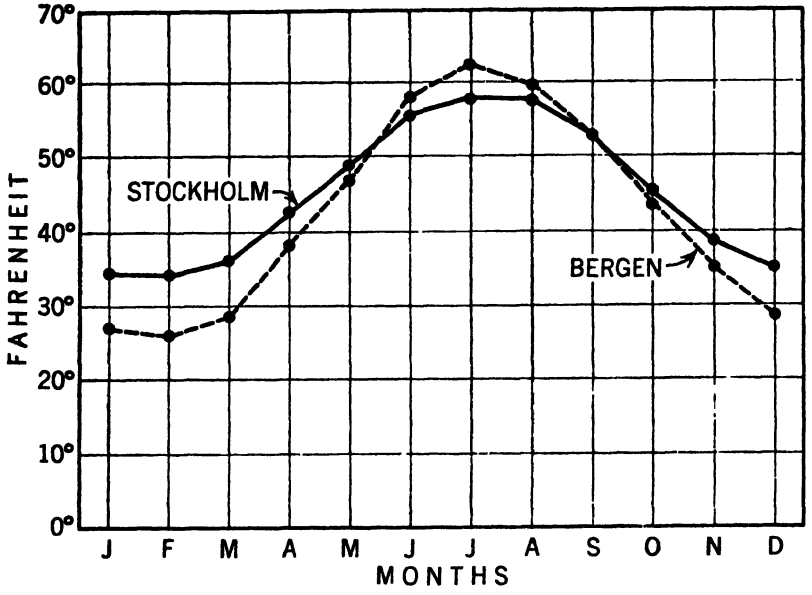


Fig. 179. Mean monthly temperatures of Stockholm and Bergen.

former is about 80 inches per year, compared with 25 inches at the latter. Moisture is well distributed throughout the year, which, in conjunction with the cool temperatures, ruggedness, and many lakes, causes both coniferous forests and water power to be abundant and widespread. The cool climate and evenly distributed rainfall cause a dense stand of trees and a slow, uniform annual growth which results in a wood of solid texture. The best quality of wood is from southeastern Norway and from Sweden, where the short summer season produces small annual growth on the trees. A conservative estimate places the potential water-power

energy at 16 million horsepower, which is equal to that of France, Germany, and Switzerland combined.

NORWAY

Forests. The wealth of Norway lies in her forests, water power, and fisheries. A quarter of the country is forested, 70 per cent of the forested area containing coniferous trees and 30 per cent deciduous trees. About two thirds of the coniferous forests are spruce and one third pine. Lumbering is conducted largely in the southeast, where Oslo Fiord is the site of important sawmills and pulp factories and Frederickstad is the leading exporter of forest products. On the west coast, Trondheim, near necessary supplies of sulphur, is important for the manufacture of chemical pulp. Originally, rough logs and lumber were exported, but recently the tendency has been to manufacture these products into more valuable articles, such as planing-mill products, matches, and pulp, for export. In this manner, wealth is increased and work is provided for more people. Accessibility of the forests, nearness of the region to industrial Europe, and the quality of the wood have favored the use of wood for these products. Forestry and lumbering are conducted scientifically, and for the past third of a century an association has set from 10 to 15 million trees annually. A quarter of the forests are owned by the state.

Minerals. Although there are deposits of several kinds of minerals, iron ore and pyrites being most important, Norway is poorly endowed with mineral wealth. The supplies would be of more value to the country, however, did not the low grade of ores and the lack of coal and of inland transportation hinder development. Coal is three or four times as costly in Norway as in the United States. The rich deposits of the island of Spitzbergen, a detached portion of the Scandinavian highland, are being developed in about a half dozen places and should be important for northern Norway.

Water power. Norway is the most favored nation of the world with regard to water power. One Norwegian engineer estimates

the total potential quantity at 15 million horsepower, while a more conservative one places it at 10 million, 20 per cent of which is developed. Everywhere near the sea is a high plateau with evenly distributed rainfall and numerous lakes to equalize the flow of the streams. This plateau is further indented with many deep fiords, with a great number of short, swift streams tumbling into them. Power, therefore, is available not only near the seaboard, but also for all of the country, without long transmission lines. In many of the fiords power plants and factories can be located at the same place, and the fiords provide harbors that will accommodate the largest freighters.

Fisheries. In Norway fishing is an industry of the first rank. The paucity of agricultural resources early turned attention toward the near-by seas, which abound in fish. Large areas of protected waters, provided by the highly indented coast line with its fringe of islands, abundant supplies of good shipbuilding timber near the coast, and a market for fish in the Mediterranean—all contributed to the rise of a fishing industry. These conditions have helped to make Norwegians the most dependent on the sea per capita of any nation. Although statistics indicate that only 7 per cent of the Norwegians are engaged in fishing, one must remember that many farmers, and other classes of people too, combine fishing with their other occupations.

The main fish caught are herring, cod, sardines, and mackerel. Norway also controls the world's whaling industry. Herring, by far the most important species caught, abounds in the fiords and around Iceland. The cod ranks second and is caught along the Lofoten Islands and northward. Salmon are caught in the fiords and rivers. Seals are found in the region of Spitzbergen, which at one time was an important whaling center. Sardines, or bristlings and small herring, have a reputation for high quality because of the tenderness of the meat and the use of improved technical processes in canning. Bergen and the Lofoten Islands are the leading fishing centers, but Aalesund has more boats

going out than any other place. Honningsvaag, however, leads in the drying and salting of fish.

The whaling industry, 80 per cent of which is controlled by Norway, is important enough to be described.

The whaling industry. Whales are caught chiefly for their oil, which is used for explosives and soap, for currying leather and batching flax, jute, and other fibers, for oiling woods, and, when highly refined, for a lubricant competing with castor oil. A small amount of ambergris, used in making perfumes, is obtained, and the cake which is left after the body is rendered may be used for fertilizer.

Improved methods and equipment have placed whaling on a larger scale than in its early days. Ships used are as large as 22,000 tons and have batteries of pressure boilers and a mouth in the bow to permit dragging the captured whale on deck. A floating factory of this sort has a much wider range for fishing than a land station. These large ships have small boats called catchers in which a part of the crew goes out and harpoons the whales and brings them to the ships. A 12,000-ton ship, with a crew of 180 men, can handle 12 whales per day. In 1927, one vessel with a crew of seventy-eight returned to Norway with 45,000 barrels of oil, the product of 473 whales. The Norwegians have an investment of about $20,000,000 in the industry, which employs about 5,000 men. Nineteen factory ships brought back products worth $30,000,000 in 1933. The homes of the factory ships are the small towns of Tonsberg, Larvik, and Sandefjord, the latter being the headquarters.

A serious problem of the industry is the gradual extinction of the whale. Recently the League of Nations adopted an international convention prohibiting the killing of right whales, which are now almost extinct, and providing for greater efficiency in the utilization of other species; Norway and Great Britain have both ratified this convention. During the past few seasons most of the companies agreed voluntarily to restrict both the catch and

the length of the season, and as a result the number killed was reduced one half. If fishing is done later in the season, more oil is obtained from each whale. Recently, the Norwegian Government has adopted more strict measures and the British companies are comforming to the Norwegian practice. In South Africa the whaling industry, which centers at Durban, has been regulated by the Provincial government because indiscriminate slaughter was driving the whale from South African waters. Most whaling is now carried on in the Antarctic waters, where Norway owns and uses Bouvet Island and Thompson Island for bases.

Agriculture. Only 3 per cent of Norway can be farmed, for arable land occurs only in narrow strips and in small plots in valleys and around lakes and fiords. The Glommen Valley is the most fertile area of any size and contains 25 per cent of the total population. A quarter of the people of the country are classed as agricultural.

Hay is grown on two thirds of the 2 million acres which are under cultivation; other leading crops are oats, barley, and potatoes.

Sheep and cattle are the most numerous of the animals grown, but swine and goats are also important. Dairying has been expanding, and some of the cheeses have a world-wide reputation.

Manufactures. The leading manufactures of Norway are forest products, textiles, electrometallurgical and electrochemical products, canned fish, and wooden ships. Oslo and Bergen now have both machine and textile industries, and, with water power, moist climate, domestic wool, and favorable location for importing cotton and shipping out finished products, Norway may some day be an important producer of textiles. Water power and location for shipping have given rise to the smelting of metals, particularly aluminum and zinc, and to the manufacture of artificial nitrate. Stavanger is the principal center for the canning of fish. Norway leads the world in the building of wooden ships, using many in her own carrying and fishing industries and selling the remainder in other countries.

Foreign commerce. Fishery products, forest products—lumber, pulp, paper—and minerals each account for 25 per cent of the exports; textiles, minerals, foodstuffs, and vehicles, including ships, are each about 16 per cent of the imports, and animal products 10 per cent. About a quarter of the total trade is with the United Kingdom, with whom imports and exports are about equal. The German Reich and the United States each enjoy about 13 per cent of the trade, and Sweden has 10 per cent. Imports exceed exports, but the trade is largely balanced by tourist expenditures and payments by foreigners to Norwegian shipowners.

Oslo, Bergen, Trondheim, Stavanger, and Narvik rank as ports in the order named.

SWEDEN

Forests. About 60 per cent of Sweden is forested; 80 per cent of this forest is coniferous, chiefly of spruce, pine, fir, and larch. Although there are sawmills along the entire coast of the Gulf of Bothnia, to which logs are floated by river, the principal lumbering center is in the vicinity of the Dal River. While the rivers are not navigable, the locating of sawmills at river mouths effects certain economies in transporting finished products to market, since they are mostly for export. Both snow and swift streams aid much in lumbering. None of the forested districts is more than a few miles from a river, and there are two annual floods because the ice in the lower courses of the rivers melts before the ice of the upper courses and the snow of the highlands. Floating logs by river is only one fourth as costly in Sweden as hauling them by rail.[1]

Like Norway, Sweden turns a portion of her forest resources into the more valuable types of products, particularly pulp and paper. Sweden produces about one seventh of the world's pulp and is a leading exporter of both pulp and paper. Pulp manufacture is expanding in the north, where the trees are small.

The leaders of Sweden have recognized that the future of the

[1] Thorsten Streyffert, "Softwood Reserves of Europe," *Economic Geography*, 10:6.

nation depends much on the way in which the forests are managed and upon the efficiency with which the wood is utilized. Consequently, both forestry and lumbering are conducted most scientifically, with government encouragement and regulation and coöperation between the state and private industry. Public regulation of private forest lands is exercised through local boards which enforce conservative methods of cutting, provide for the growing of seedlings and for resetting cutover lands, protect the forests against fire and insect pests, and carry on educational work

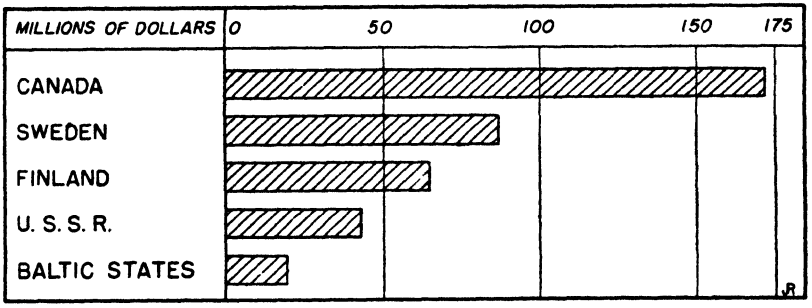


Fig. 180. Exports of forest products from the principal exporting countries in 1935.

in forestry among the public. A number of schools also offer courses in forestry.

The wood that is cut is probably used more efficiently here than in any other country. Small dimensions are made into such products as matches and spools for thread. Large amounts of alcohol and other products are also obtained. This complete utilization is facilitated by the large size of many of the sawmills and in some cases by integration of lumber companies and pulp companies.

Almost half the forest acreage is owned by farmers, a third by the government, and the remainder by large holders, chiefly lumber and pulp companies.

Water power. Sweden has 6 million horsepower of potential water-power energy, of which a quarter has been developed. The rivers of Sweden have their sources in lakes and flow to the sea over a series of falls. They are, however, frozen for a part of the

year. The greater resources are to the north of the Dal River, but the Gota River supplies the larger part of the developed power. More than half the farms of Sweden have electricity.

Minerals. The mining of iron ore is an important industry in Sweden. Ore of high quality is mined at Kirunavaara and Gellivara, where the largest body of magnetite iron ore in Europe is found; another center is at Dannemora and a smaller one at Grangesberg.

Since Sweden lacks coal, she must export most of her iron ore, chiefly to Germany and Great Britain, for smelting. Water transportation favors this, but most of the ore from the northern field moves through Narvik in Norway—a necessity in winter when the Gulf of Bothnia and the Baltic are frozen. A new government hydroelectric plant at Porjus may help to develop smelting in this field.

Agriculture. About 12 per cent of the area of Sweden is farmed. Half of the land under cultivation is in hay; hardy cereals, particularly oats, and root crops are also important.

Cattle and swine are the principal animals, the former being twice as numerous as the latter. As in Norway, dairying is important; the skim milk is fed to the swine.

Less than half the people of Sweden are classed as agricultural, and for some time there has been a movement toward greater industrialization and a resulting migration of people to the cities.

Manufactures. Forest and metal products and textiles are the principal manufactures of Sweden. Owing to inability to compete with large centers which have abundant supplies of coal in the manufacture of cheap, bulky metal goods, such products as ball bearings, cream separators, and electrical equipment are made. Before the use of coal revolutionized the industry, Sweden was the leading manufacturer of iron and steel, and it is still an exporter of high-grade cutlery and similar steels. Göteborg is a cotton center and Norrköping makes both cottons and woolens. Because of its excellent system of waterways for transportation, the lowland between Göteborg and Stockholm might be an important

industrial center had Sweden cheap coal. Sweden is also an important builder of wooden ships, processes many agricultural products, and makes distinctive potteries.

Foreign commerce. Products of the forest account for half the exports of Sweden, and minerals for a quarter; minerals and their manufactures comprise more than a third of the imports, food products a quarter, and textiles a sixth. The total trade is usually a little more than double that of Norway. The United Kingdom has recently taken 25 per cent of the exports, the German Reich 14 per cent, the United States 12 per cent, and Norway and Denmark combined, 12 per cent. The German Reich has supplied 25 per cent of the imports, the United Kingdom 20 per cent, the United States 12 per cent, and Norway and Denmark combined, 12 per cent. Imports exceed exports and are balanced by earnings on foreign investments and tourist expenditures.

Göteborg is the leading port, followed by Stockholm, and Malmö is an important ferry and packet-service station for trade with Denmark. Swedish ports are not open the year round as are those of Norway. The entire Baltic freezes in severe winters, and the Gulf of Bothnia freezes for five months every winter.

Economic problems of Norway and Sweden. Norway and Sweden, unlike most other European countries, are not burdened with heavy war debts. Nevertheless, owing to their dependence on foreign commerce, they have not escaped postwar problems. Economic nationalism and world-wide depression have restricted foreign markets and have limited the demand for the services of Norwegian ships; unemployment and lowered incomes have resulted. Attempts have been made to meet these problems by enactment of social security policies and official encouragement of coöperative business establishments.

32

THE GERMAN REICH

Factors in development. The German Reich, now 260,474 square miles in area and with almost 87 million people (includes the protectorates of Bohemia, Moravia, and Slovakia), has taken its place among the nations of the world since 1871, the year various states were united in a confederation. Although there are several other influences which help explain the rapid progress, the active part taken by the central government to develop commerce and industry and the qualities and capabilities of certain of the nation's early leaders are important. For the time at least, much that had been accomplished has been lost because of the World War. For centuries, however, the Germans have been accustomed to adversity, which has developed in them the ability to overcome many handicaps.

Except for reserves of coal and potash, the nation is poorly endowed with natural resources; much of the naturally poor soil has been brought to a high state of productivity (see p. 506) only because of intensive methods of cultivation which were made easier by the cheap supplies of potash. The agricultural industry has thus been a good training ground for the development of the scientific qualities for which the Germans have become noted. More recently these scientific abilities were applied in the utilization of the coal resources, Germany's great chemical industry being the result, and now they are being applied in still other directions.

The necessities created by the poor endowment of resources and the consequent achievements have shown the importance of technical education, with the result that government and industry both

contribute funds for this purpose. College-trained men, whatever their specialty, take an important part in the affairs of industry and of the state.

The teachings of statesmen and of great thinkers and philosophers have been important in uniting the minds of the people regarding their duty to country and impressing upon them the greatness and future place of Germany; and the discipline of the school and of military training has made them obedient and willing to follow the advice and orders of their leaders.

Geographic features. The German Reich is made up of two natural regions: the northern plain and the southern highlands. The latter, somewhat the larger of the two, contains small but important sections of the Rhine, the Elbe, and the Danube Valleys. In the southern part of the highlands are the important Vienna gateway between the Alps and the Carpathians and the Brenner and Semmering passes overlooking Italy, important both for commerce and for military purposes.

The features of the plain are due partly to glaciation. A large part of it is covered with poor, sandy soil. There are also deposits of glacial clay in which swamps and marshes sometimes occur. Where these clay deposits are drained, they provide fertile spots for crops, and large areas have been reclaimed for this purpose. Alluvial deposits brought from the highlands by rivers provide other fertile districts. These rivers, with their sluggish currents, freeze easily. Because of this fact and the northward direction of the rivers, spring floods add to the area of swamp land. About fifty miles inland from the coast are the Baltic Heights, a low plateau or ridge with lateral projections which consists of piled-up glacial material with lakes in the depressions. These heights, heavily forested with pine trees, afford vacation and health resorts.

The highlands are geologically complex, with a resulting topographic diversity characterized by low ridges and fertile intervening valleys and basins. The Bavarian plateau is similar in structure to the Paris Basin, but more elevated and with bolder escarpments; it is therefore more rugged and more suited to forests

than to crops. This plateau is dissected by the Danube River, which flows along the line of junction between the Juras and the Alpine foreland. The northern half is more fertile than the southern, containing many valleys in which cereals and fruits are grown. From the Alps to beyond Munich is a dry, infertile district of coarse glacial material washed down from the Alps.

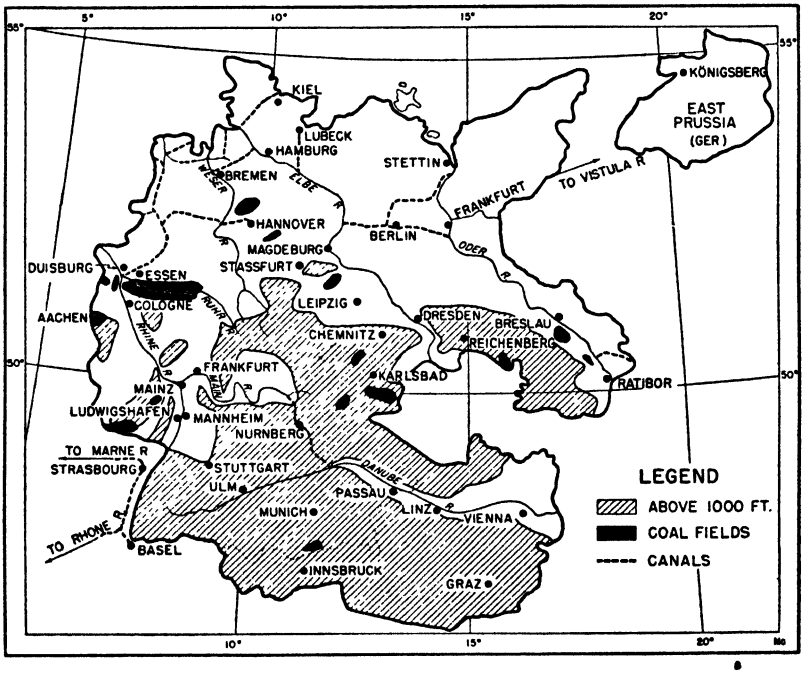


Fig. 181. The German Reich.

Swamps occur where underlying rock emerges from beneath the glacial deposits. This section has poor forests and some water power and supports a pastoral industry. Grazing and lumbering are important throughout the highlands, and those parts which are older geologically contain deposits of several minerals. The southernmost section of the highlands lies in the most heavily forested part of the Alps, and has (in addition to good timber) water power, mountain pastures, and scenery for attracting tourists.

Along the edges of the highlands adjoining the plain are the coal deposits. Here also is a row of large cities, among which are Breslau, Dresden, Leipzig, Magdeburg, and Hanover. They originally were, and still are, route centers at the junction of plain and highland. Because soil brought from the highlands made the plain more fertile along this edge, these cities began as agricultural market centers, but they have grown since manufacturing arose near the coal deposits.

The Rhine lowland, about 12 miles in width and extending for 200 miles from Basel to Mannheim and Frankfort, is an important connecting link between many parts of Europe. At both its northern and southern ends, routes extend in three directions, and there are several lateral routes along its course. As a result of its favorable location in commanding routes and commerce, together with the navigability of the Rhine, this lowland has become highly industrialized and is one of the most densely populated parts of Europe. Being sheltered, it is also a good agricultural section, even being warm enough to grow some of the Mediterranean crops. The Danube Valley around Vienna is the best agricultural section of southern Germany. Vienna, at the junction of highland and plain and commanding the Austrian gateway, has several important international routes converging on it.

Climate. Differences in topography, position with respect to the sea, and latitude cause variety in climate, although elevation in the south tends to offset the more southern location, compared with the plain. At Karlsruhe in the Rhine Valley the average temperature for the three summer months is 64.8°, at Munich in the highlands, 61.4°, at Berlin in the east central plain, 63.3°, and at Poznan, across the border in Poland but characteristic of the eastern plain, 64°. The average temperature for the three winter months at Karlsruhe is 34.2°, at Munich 28.8°, at Berlin 32.2°, and at Poznan 29.9°. Only the Rhine Valley has temperatures in winter like those of France or England.

In the plain the annual rainfall ranges from 28 inches in the west to 16 inches in the east, while in the south, because of ele-

vation, it ranges from 80 inches in the higher parts of the Black Forest to 30 inches in lower places and in the east. Winter rainfall is light except at the highest elevations. Austria has climatic variety because river valleys face outward in different directions; all the valleys are warm in summer, but those which face the plain to the east are coldest in winter.

Protection and southern exposure give many of the nation's mountain valleys a warmer climate and a longer growing season than in the remaining parts of the country.

Forests. Forests cover 30 per cent of the German Reich and have an important place in the national economy. About two thirds are coniferous and one third deciduous. The Baltic Heights have pine, spruce, and fir. In the deciduous districts the oak predominates in the south and the beech on the dry, sandy soils along the Baltic. About half of the forested area is publicly owned, and forestry is conducted along scientific lines. Permits must be obtained to cut trees, and young trees must be set to replace those that are cut. Although lumber, which goes down the Danube to Hungary, is the leading export of the Austrian section, heavy imports of lumber are necessary to supply the demands of the nation.

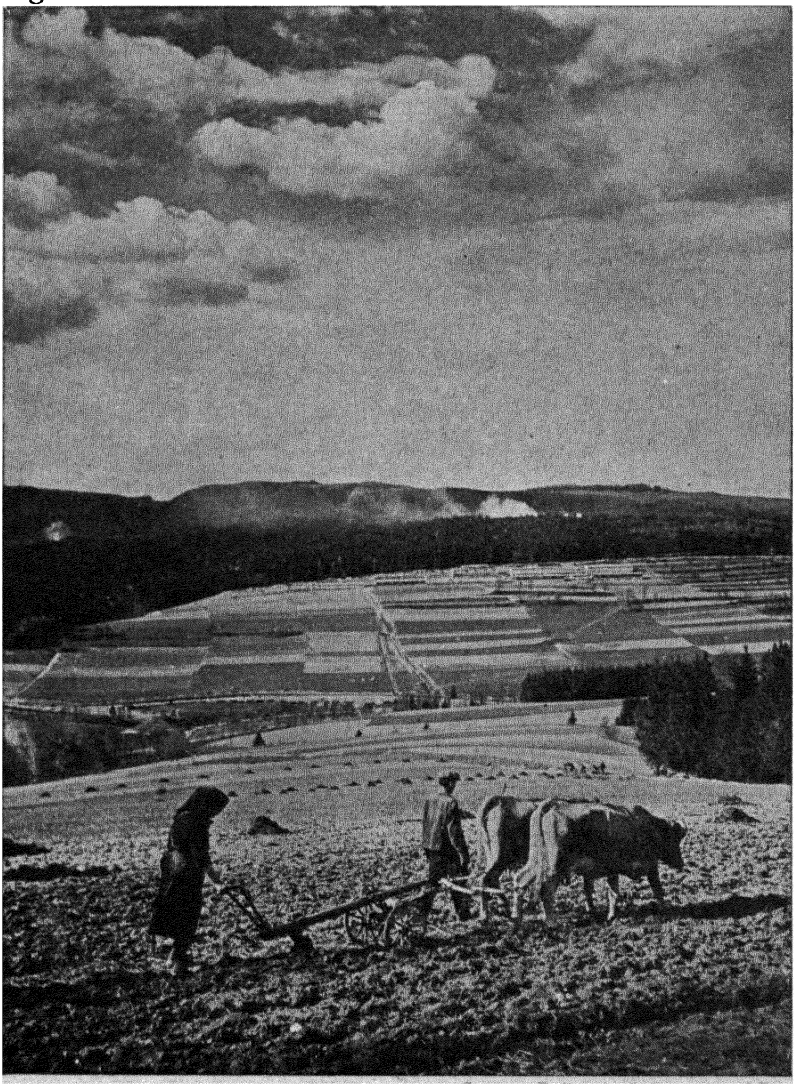
Minerals. Although there exist deposits of several minerals, only coal, potash, and magnesite occur in important quantities. The first two have been major factors in the progress of the nation, the coal for industrialization and the potash for improving the soil. Although the lower Rhine Valley and Silesia are the major mineral areas, there are others, chief of which is the district extending southeastward from the Harz Mountains through the Erzberg and the Sudetes. All three of these areas have coal, but that of the last is largely of poor quality and the reserves are not large. There are deposits on both sides of the lower Rhine, but about 80 per cent of the total production is from the Westphalian or Ruhr district, which also contains about 60 per cent of the known reserves. On the west side of the Rhine are the deposits of the Saar Basin and those which are extensions of the fields of

Belgium and the Netherlands. The coal of this area is of good quality and because of water transportation competes with British coal in near-by markets. Germany dominates the land trade in coal in Europe, as Great Britain dominates the water trade. The Silesian field is one of the largest in Europe, but it is now divided among three nations, Poland holding the largest share. The coal is inferior to that of the Rhine region. The known reserves are about equal to those on the west side of the Rhine, not including the Saar, which has known reserves about 50 per cent greater. It is thought, however, that Silesia may have possible reserves as great as those of the Rhine region. The chief mining centers are Breslau and Waldenburg. One should note that the main coal fields are on the edges of the country, where the deposits extend across into neighboring countries.

Germany leads the world in the mining of lignite, or brown coal. The tonnage mined is somewhat more than that of coal, but 9 tons of lignite are considered the equivalent of 2 tons of bituminous coal.[1] It is mined by open-pit methods and, after the fuel oil is extracted, is turned into electricity at the mine. The Thuringia-Saxony field leads, but there are also deposits in Hesse and in southern Bavaria and Austria. The Sieg Valley contains the leading deposit of iron ore, and the Harz Mountains, near Mansfield, contain the principal deposit of copper ore; the Rhine, the Harz, and the Sudeten districts all have a small output of several other minerals. There is also iron ore near Eisenerz in the south. This section leads the world in the mining of magnesite and ranks high in the production of low-grade, amorphous graphite. The latter supplies central Europe with material for foundry facings and cheap lubricants. Germany leads the world in the production of potash, from deposits at Stassfurt that are estimated to be extensive enough to supply the world for 2,000 years at the present rate of consumption. These deposits, with the immense reserves of phosphate rock in the Atlas countries, should mean much for densely populated Europe.

[1] L. D. Stamp, *An Intermediate Commercial Geography*, London, Longmans, Green & Company, 1929, p. 692.

Water power. According to conservative estimates, the German Reich has about 4 million horsepower of potential water power—85 per cent as much as France—60 per cent of which has been developed. It exists largely in the south, where coal is lacking, and has been important in the development of manufacturing in the Bavarian and Austrian sections.



German Railroads Information Office.

Fig. 182. Working in fields in German highlands.

Agriculture. About 62 per cent of the total area of Germany is under cultivation, pastures and meadows occupying 46 per cent of the land under cultivation, cereals 40 per cent, root crops 11 per cent, and horticultural products 3 per cent. The plain is the leading agricultural area, about half of it being in tilled crops and a quarter in pasture; the remainder is in forest.

German agriculture, like that of most other North Sea countries, is characterized by its intensive methods and high yields. Comparative yields of these and of other countries follow:

AVERAGE COMPARATIVE YIELDS IN BUSHELS PER ACRE FOR SELECTED CROPS, 1931-33

	Wheat	*Rye*	*Oats*	*Barley*	*Sugar Beets*[a]	*Potatoes*
U. S.	13 5	10.5	26.	18.5	11 4	105 6
England and Wales	32 5		55 1	37 2	9 5	
France	23 6	19 3	41 2	28 6	11 2	167 9
Germany	32 5	28 3	56 3	37 8	12 8	232 8
Belgium	37.8	39 7	69 9	48 9	13 8	318.2
Denmark	42 5	27 9	71 9	51 5	15 8	250 9
Spain	13 5	14 9	25 0	22.8	12 4	
Hungary	19.3	18.6	32 7	25 4	8 8	82 5
U S. S. R.	9 8	13 8	21 2	15 9	3.6	..
Argentina	13.3	8.1	28.2	21 5	.	..
Australia	12.6	...	16 5	19.0	...	.. .

[a] Tons per acre.

Small farms and peasant proprietorship prevail, except in the northeast, where there are still many large estates.

Crops. The acreages of the principal crops are given in Figure 184. Rye, oats, and potatoes occupy the poorer soils, in the plain, and wheat, barley, sugar beets, and horticultural crops are grown on fertile soils along the main river valleys and in basins and valleys of the highlands. The great rye belt of Europe begins in northwestern Germany and extends across Russia, the soil being too infertile and poorly drained, the summer too cool and moist, and the winter too severe for wheat to thrive; this is why so much black or rye bread is eaten in Germany and countries farther east. The oats are grown along the edges of the rye belt—along the Baltic coast and along the northern edge of the highlands—

possibly indicating that they require a better soil than rye. The crop is used for animal feed, much of it for dairy cows, in a region too cool for corn. The acreage in wheat has expanded rapidly for the past few years until production is about half that of France. Previously much wheat had been imported, particularly in the industrial centers, but at present imports are only one sixth of the domestic production.



German Railroads Information Office.

Fig. 183. The hay harvest in the valley of the Netze, in the plain of eastern Germany.

Germany stands next to the U. S. S. R. in the growing of potatoes, which do well under the same conditions as rye, and ranks after the U. S. S. R. in sugar beets, which are grown on fertile soils, largely in the same region with wheat. Various horticultural crops are grown in the southwestern highlands, fruits, particularly apples, grapes, and hops, being important. The hops are used in making beer, for which Germany is famous; barley is also grown chiefly in these highlands. Germany is the leading

apple producer in Europe, Stuttgart being the leading center, and Wurzburg is the center of the wine industry. The Rhine Valley is also important for grapes and wine. Some of the vineyards are planted on the terraced slopes, which are some of the most valuable farmlands to be found in Europe.

Animal industries. The cool, moist climate, poorly drained soil, and much rolling land combine to give Germany a high density of animals per unit of land. Except for swine, which are important in the potato districts, the animals are raised largely along the cool, moist Baltic coast and in the highlands. The most

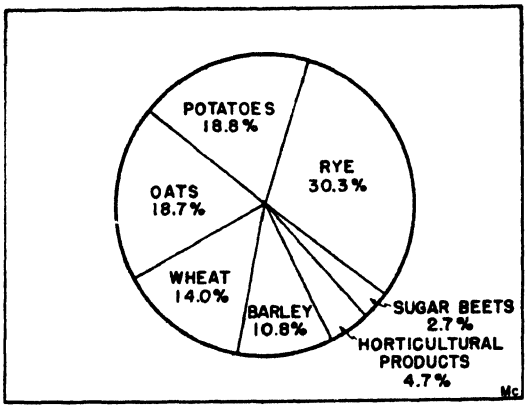


Fig. 184. Relative acreages of principal crops of Germany in 1936.

important region for swine is the dairy section of the northwest. They comprise about 45 per cent of the total number of animals, and cattle 37 per cent. The swine are fattened on potatoes (40 per cent of the crop is used in this manner), barley, and skim milk. This industry has prospered because of government encouragement. Although dairying is widespread, it concentrates in the cool, moist northwest and in the Alps, where high mountain pastures provide the basis for a summer industry. There are large numbers of goats and sheep. In recent decades the number of sheep has declined rapidly while the number of cattle was in-

creasing, a usual occurrence as population and industrialization increase. There are many horses in Germany, but to a large extent cattle are used for draft purposes. This is another indication of the relatively low standard of living prevailing, although this use of cattle may have been increased by the killing of horses during the World War.

Manufacturing. The German Reich is primarily an industrial country, about two thirds of the population, roughly the same



German Railroads Information Office.

Fig. 185. Locomotive works at Hanover.

proportion as in the United States, being classed as urban. There are a large number of widely distributed industries, but manufacturing is concentrated largely around the coal measures. All types of manufactures, from those of the heavy industries to those which require little power but considerable skill, are made.

Five different manufacturing centers may be noted: (1) the lower Rhine section between Cologne and Ruhrort, including the Ruhr and other valleys to the east and the Aachen and Saar districts to the west; (2) the area extending from the Sudetes and

the Erzberg to the Harz Mountains, (3) Silesia, (4) the Bavarian highlands, and (5) Austria.

The leading manufacturing center is the Ruhr Valley, which is probably more highly industrialized than any other area of equal size in the world. It is an iron and steel center and manufactures hardware and cutlery. Essen, the home of the Krupp factory, is the leading city.

To the south of the iron and steel district is the Elberfeld-Barmen textile center, where all types of textiles are made; across the river is Krefeld, the leading silk-manufacturing city, and Aachen, which is famous for its woolens and also smelts lead and zinc ores. Iron and steel goods are the principal products of the Saar Basin.

The Rhine Valley also has a great chemical industry. Ludwigshafen is the leading center, but Cologne and Frankfurt and the textile cities are important; the last provide a market for many of the products.

The Rhine area, because of water transportation and coal, is important for both heavy industries and those which work up a variety of imported raw materials. Cologne makes chocolate, Mannheim vegetable-oil products, and the processing of foodstuffs is widespread.

In the Sudetes-Erzberg-Harz district are textile, metal, pottery, chemical, glass, and leather manufactures and sugar refining and other industries. The leading industry by far is the manufacture of textiles, primarily cotton goods. Saxony, largely at Chemnitz and Zwickau, is the leading textile center of Europe. In the Sudetes, principally at Reichenberg, and along the eastern base of the Erzberg, where water power is available, are other important textile districts. Dresden manufactures machinery, and Meissen not far away makes pottery—the famous Dresden china. Another pottery center is at Karlsbad, where there are large deposits of kaolin near lignite. The salt and other minerals of the upper Elbe Valley provide the basis for a chemical industry and for the

associated product, glass, much colored glass being made here. The district around Gablonz is important for artificial jewelry and beads. Stassfurt is another chemical center, making fertilizers and also chemicals for the textile factories in Saxony and other places. Various types of leather products are made in the region, and the Erzberg area has both an important household and a factory toy industry. Magdeburg is the principal center in refining beet sugar. Leipzig, a trade and financial center, is noted for printing, the dressing of furs, and the manufacture of pianos.

Iron and steel and woolens are the principal products of Silesia. Breslau, a route center in a rich agricultural basin and with several minerals near by, is the leading city of the region and manufactures machinery and woolens. The latter industry started in the region with local supplies of wool but depends now partially on imported wool. Ratibor in the extreme southeast manufactures paper.

The Bavarian highlands lack coal but have water power and lignite, both of which are turned into electricity at a relatively high cost. Consequently, as in the adjacent parts of France, products of high quality and high value are made. Because of the abundance of wood, several places have small woodworking industries. Nürnberg is the toy capital of the world, ranks second only to Berlin in Germany for electrical equipment, and manufactures glass, chemicals, pencils, and different kinds of scientific instruments. Germany is especially noted for the last. Munich is one of the foremost cities in the world for brewing, and it makes instruments, pencils, locomotives, and automobiles. It obtains power from the Isar River. Stuttgart has printing, hosiery, and cotton industries; and Heilbronn is a growing iron and steel city.

It should be noted that each of these four manufacturing areas has access to water transportation on one of the large rivers of Germany. The lower Rhine area is located most favorably in this respect, the southwestern highlands least so.

Austria, the industrialized section of a former empire that was balanced economically, manufactures many different kinds of

products. Lacking important reserves of coal, but having water power, cheap and industrious labor, and a moderately good location for conducting foreign trade, she makes the more valuable types of goods which characteristically result from such conditions. The leading industries are the manufacture of textiles, machinery, automobiles, leather goods, furniture, and pulp and paper. Steyr is an iron and steel center, obtaining ore from near Eisenerz. Graz and Klagenfurt are centers for machinery and other metal products. Dornbirn leads in the manufacture of cotton goods, and the Tyrol in silk goods. Vienna has metal, leather, and other industries.

Waterways. The German system of internal waterways, and especially the Rhine, is so famous that it seems proper to describe it here. Practically all of Germany is contained in the basins of the four rivers which flow parallel to each other. These rivers are all connected by an extensive network of canals, and are connected in a similar manner with the rivers of Poland and those of France and the Low Countries. The construction of canals has been easy because of the level plain and transverse valleys or depressions, which are thought to be the beds of former drainage systems. Traffic is provided by the exchange of goods between agricultural sections and the western industrial centers.

The development of the German waterways, and of the railways also, has been a part of the plan for national defense. More recently, the network of concrete highways is being constructed to serve the same purpose. The waterways carry cheap, bulky, slow-moving traffic; in prewar times they hauled about 20 per cent of the traffic of the country.

The western rivers are more useful for navigation than the eastern, the latter being smaller and frozen for a longer period; they empty into the Baltic, which is frozen for several months each winter. The Rhine at Cologne is frozen on an average for 21 days each year, compared with 61 days at Stettin on the Oder.

The Rhine is among the world's leading navigable rivers, largely

because it flows through the heart of a great manufacturing district. Bulky food products and raw materials are imported and large quantities of manufactured goods exported. In addition there is considerable interchange among the different economic units along the Rhine. Leading in tonnage upstream are grain and coal; downstream, lumber and salt from the Neckar region. Other advantages of the river are its depth and uniform flow, which results from the uniform distribution of rainfall and the fact that its source is in the snowfields and lakes of Switzerland. Several of the tributary streams are also navigable. The depth is 30 feet at Cologne, which is the furthest point for ocean vessels. Mannheim is the head of river steamer navigation, but smaller boats can reach Mulhouse, and small barges can go as far as Basel. Barges of 2,000 to 3,000 tons' capacity can be accommodated at Mannheim, and barges and boats of 400 tons above there. That city is one of the world's leading river ports, being both a railway center and a river junction.

Foreign commerce. Germany, like Great Britain, must normally place great dependence upon foreign trade. Raw materials and food products predominate among the imports (Fig. 186), manufactured goods among the exports. The sources of imports and markets for exports recently have been widely distributed, no one country having a very large proportion of the total. The United States and the United Kingdom, the Netherlands, the U. S. S. R., France, and Argentina have been most important.

Hamburg is the leading port, followed by Bremen. Large amounts of German trade also go through Rotterdam, Amsterdam, and Antwerp. Stettin, the port for Berlin, is the leading Baltic port. German ports handle some transit trade destined for the interior of Europe or moving out from there. There are shipbuilding industries in all of the important ports, and some ports manufacture food products from imported materials.

Hamburg, with a 30-foot channel, is one of the greatest of seaports, ranking with New York City, London, and Liverpool. It

has been necessary to spend immense sums to expand and modernize it in accordance with the needs of traffic. It remains open to traffic the year round, but ice breakers ordinarily must be used for several days each winter.

Germany's industrial and commercial problems. The loss of sources of raw materials and foreign markets and financial impoverishment, results of the World War, have created difficult industrial and commercial problems which have been aggravated recently by world-wide depression, growing world economic

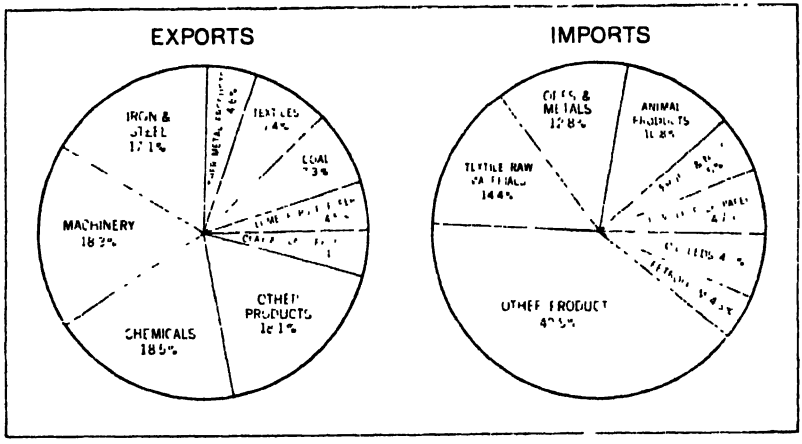


Fig. 186 Principal items in the foreign commerce of Germany in 1936 (Former Austria included.)

nationalism, and some of the present internal policies of the nation. Lacking sufficient domestic supplies of raw materials to keep her factories and workers busy, Germany must obtain foreign supplies of these materials, and with declining exports the problem of paying for them becomes more difficult. Barter, trade agreements, and autarchy have been used as partial solutions. Autarchy is, however, motivated in part by militaristic considerations. When foreign trade is hindered as it has been in Germany, there is a smaller amount of raw materials for each person to work with, and since productivity is less, each person receives less wages,

and the standard of living declines accordingly. Through autarchy, Germany may succeed in making herself largely self sufficient, but only at greater social cost than if she could rely upon foreign trade. Autarchy may be accomplished without regard to the cost, the standard of living declining as a result.

33

POLAND AND THE CONTINENTAL BALTIC STATES

Historical factors. Before the World War the four continental Baltic states—Finland, Estonia, Latvia, Lithuania—were included in the Russian Empire; and Poland was divided among Russia, Germany, and Austria-Hungary, two thirds of it being under Russian control. All of these countries had not always been controlled in this way, for Poland and Lithuania at one time were strong powers. Their strategic location for the purposes of other powerful countries and the lack of natural boundaries encouraged and made easy their conquest. For centuries the Germans had been penetrating the three small Baltic states, acquiring control of a large part of the land; and, between them and the Russians, the peasants had been exploited unmercifully. Foreign domination, however, failed to crush the spirit of racial patriotism and group unity. The result was that, after the World War, since they represented ethnological groups, it was thought best to establish independent countries. These countries were also to serve as buffer states, Poland to weaken Germany, and the Baltic States to shut Russia away from the Baltic Sea; this policy was in accordance with the desires of the Allied Powers in western Europe. Finland and Estonia now control the only direct outlet which the U. S. S. R. has to the Baltic.

POLAND

Area and population. Poland is about 65 per cent as large as Germany and has about 45 per cent as many people. This difference in population may not always prevail, since the forests,

minerals, and agricultural land provide the basis for a greater industrialization than has taken place. Industrial backwardness may be due largely to the stagnation which resulted from the foreign domination and oppression which prevailed for more than a century previous to the World War.

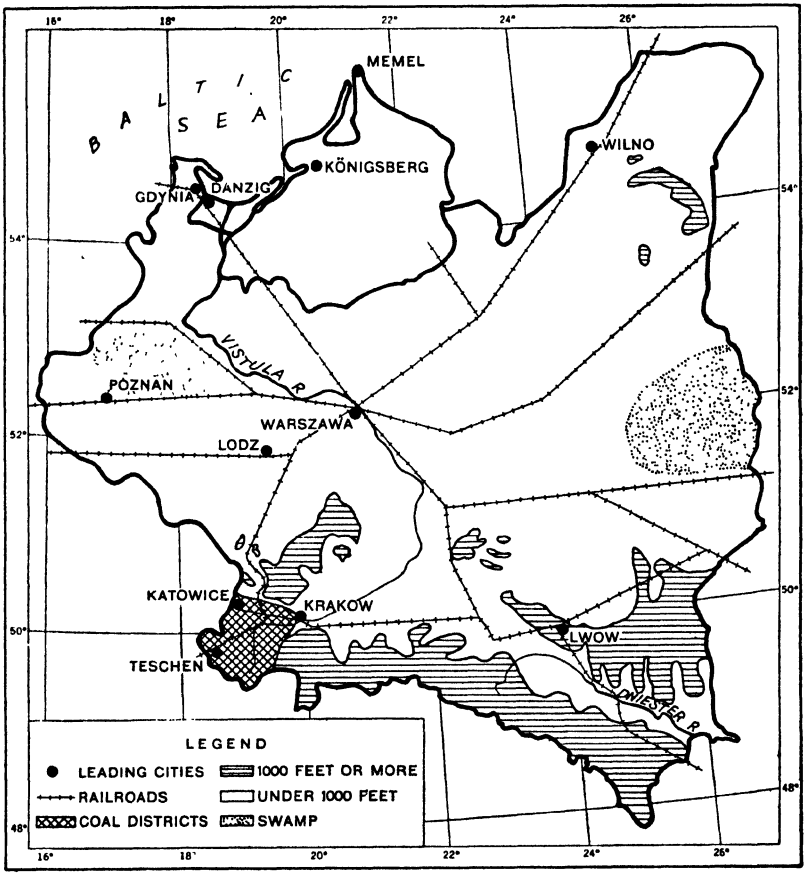


Fig. 187. Poland and East Prussia.

About 70 per cent of the people are Poles; the remainder are largely Ruthenians, with some Jews and Germans, the latter being particularly important in the industrial area of the southwest, where they occupy dominant positions in manufacturing corporations.

Geographic features. Topographically, Poland resembles Germany, except that the central highlands are not so marked. From south to north three regions may be noted: (1) a small area of mountains, (2) a plateau, and (3) a plain which comprises a large portion of the country. The plain is bounded on the east by the Pripet Marshes and on the west by the Poznan Marshes, and is separated from the Baltic coast by the low Baltic Heights.

The plateau, lying between the marshes (obstacles to transportation) and the mountains, has been an important route from western Europe to the Black Sea. Several natural routes converge on this region, and it has been of considerable military importance as a result. Krakow is located so that it controls the Moravian gate, and Lwow, the gateways of the Carpathians.

Climate. Poland has the moderate type of climate characteristic of central Europe, more distinctly continental, however, than the climate of Germany. The rivers are frozen for several months in winter, and, since they flow northward, they contribute to the areas of swamps. Although there are heavy snows in winter, the maximum rainfall occurs in summer and averages 25 inches annually.

Forests. About 20 per cent of Poland is forested, and, although the forests are not cared for as scientifically as are the forests of some other European countries, they are managed well enough to provide a large annual growth, and are an important element of the national wealth. Although hardwoods predominated originally, they have been largely cleared to obtain agricultural land, and now conifers, chiefly pine, in the Carpathians and in the sandy plain of the north and east, are more important. The forests supply fuel and lumber for domestic use and wood for woodworking and pulp and paper industries, and are the source of one of the major exports.

Minerals. Southwestern Poland is rich in power minerals and in other minerals, which provide the bases for important manufacturing industries. Most important is the coal field bordering

on both Germany and Moravia, the deposits being largely in the upper Klodnitz basin. North of Katowice lie iron, zinc, and silver-lead ores. Important deposits of petroleum occur around Baryslav, and deposits of salt which are said to be inexhaustible are located near Krakow. Salt is the raw material for a chemical industry. There is pottery clay in the beds of lakes which formerly covered some of the region.

Agriculture. The agriculture of Poland is similar to that of Germany; the methods, however, are less intensive. Until recently large holdings were the rule, 18,000 people at one time owning 40 per cent of the land. Recent legislation provides for partitioning the estates and limiting the size of the farms. With 75 per cent of the people engaged in agriculture, Poland has a higher density of agricultural population than any other European countries except Italy and the Low Countries. About half the country is made up of arable land, and 15 per cent is in pasture and meadow. The acreage in crops is only slightly less than in Germany, and the staple crops rank in the same order as in that country (Fig. 184); rye, however, is relatively somewhat more important than in Germany. Other crops are flax, hemp, hops, and chicory. Poland ranks next to Russia as a grower of fiber flax.

Cattle, swine, sheep, and horses all are numerous, and there are exports of dairy products, pork, and farm horses to some of the countries to the west.

Manufactures. Poland has varied manufactures located chiefly between Warszawa and the southwest border. The control of manufacturing plants is mainly in German hands. The leading industries are the manufacture of textiles and metal products; others are the manufacture of leather and fertilizer, the refining of sugar and petroleum, the milling of lumber, and distilling and brewing.

Lodz is the leading textile center, but Warszawa also is important; both cities rank high in metal products and leather goods. The nation has about 2 million cotton spindles. The southwest

leads in the manufacture of metal products and machinery, the district around Lwow in the refining of petroleum, and Poznan in the manufacture of liquors.

Foreign commerce. The important articles of the foreign commerce of Poland are given in Figure 188. Coal goes chiefly to the countries across the Baltic, but also to those of the Danube region by way of the Moravian gateway. As a rule, exports slightly exceed imports. Of late, the United Kingdom has been

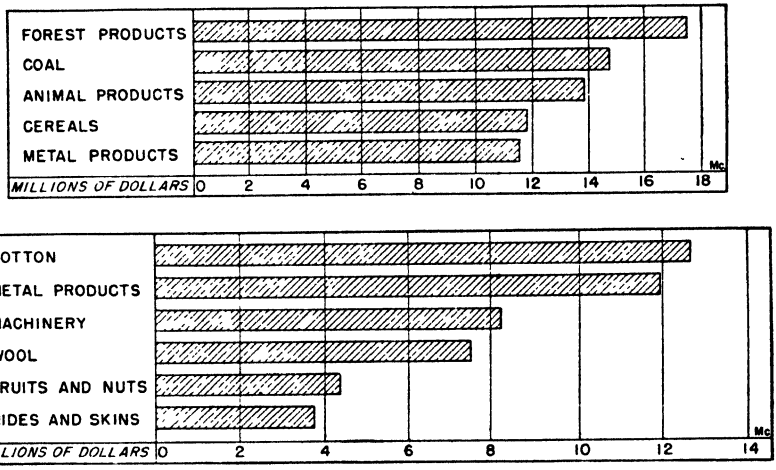


Fig. 188. Principal items in the foreign commerce of Poland in 1925; exports above, imports below.

a market for 20 per cent of the exports and has provided 11 per cent of the imports, followed by the German Reich with about 16 per cent of each.

The leading seaport is Gdynia, a former fishing village, improved to lessen the dependence of the Poles on the Free City of Danzig, which has a large German population. This port is modern and has grown rapidly, now having a free zone; and its annual tonnage is greater than that of Danzig. The navigable Vistula is an important asset for importing and exporting. The east-west land routes that cross the plateau of Poland make it a gateway for traffic between western Europe and the U.S.S.R. Warszawa, situated on the Vistula, is the principal railway center.

FINLAND

Geographic features. Finland is a rolling, low plateau of old hard rocks similar to those which form the Laurentian upland in Canada. The country has been heavily glaciated, and a third of the total area is covered with lakes and swamps. Overland transportation is difficult because of much water surface, but there are 2,500 miles of navigable waterways. The larger lakes are connected with each other and with the Gulf of Finland by canals. The southwestern coast is indented, making good harbors and fishing grounds. Finland is about 90 per cent as large as Poland but has only 10 per cent as many people.

Climate. Finland, shut off to some extent from the ocean winds and with no barrier against the cold winds from Russia, has a continental type of climate, with winter temperatures similar to those of central and northern Sweden and summer temperatures approaching those of southern Sweden. Rainfall is light, only the southwest having more than 20 inches annually. Light rainfall is characteristic of the entire Baltic area, but its dependability and favorable distribution, the cool climate, and water-holding soil make the small amount ample for the needs of agriculture.

Natural resources. The natural resources of Finland are forests, water power, small amounts of iron ore and copper ore, fisheries, and a limited amount of agricultural land. Forests similar to those of Sweden cover 75 per cent of the total area. Forty per cent belong to the state, and they are so managed that the annual growth exceeds the annual cut. Rolling topography and many lakes create favorable conditions for water power, there being a potential amount of 1,800,000 horsepower, of which 20 per cent is developed. The power site at the Imatra rapids on the Vuokski River is among the largest of Europe; its development is 216,000 horsepower. The large area in lakes and streams makes fresh-water fisheries important, and there are salt-water fisheries along the indented coast between Helsinki and Hangö. Fish

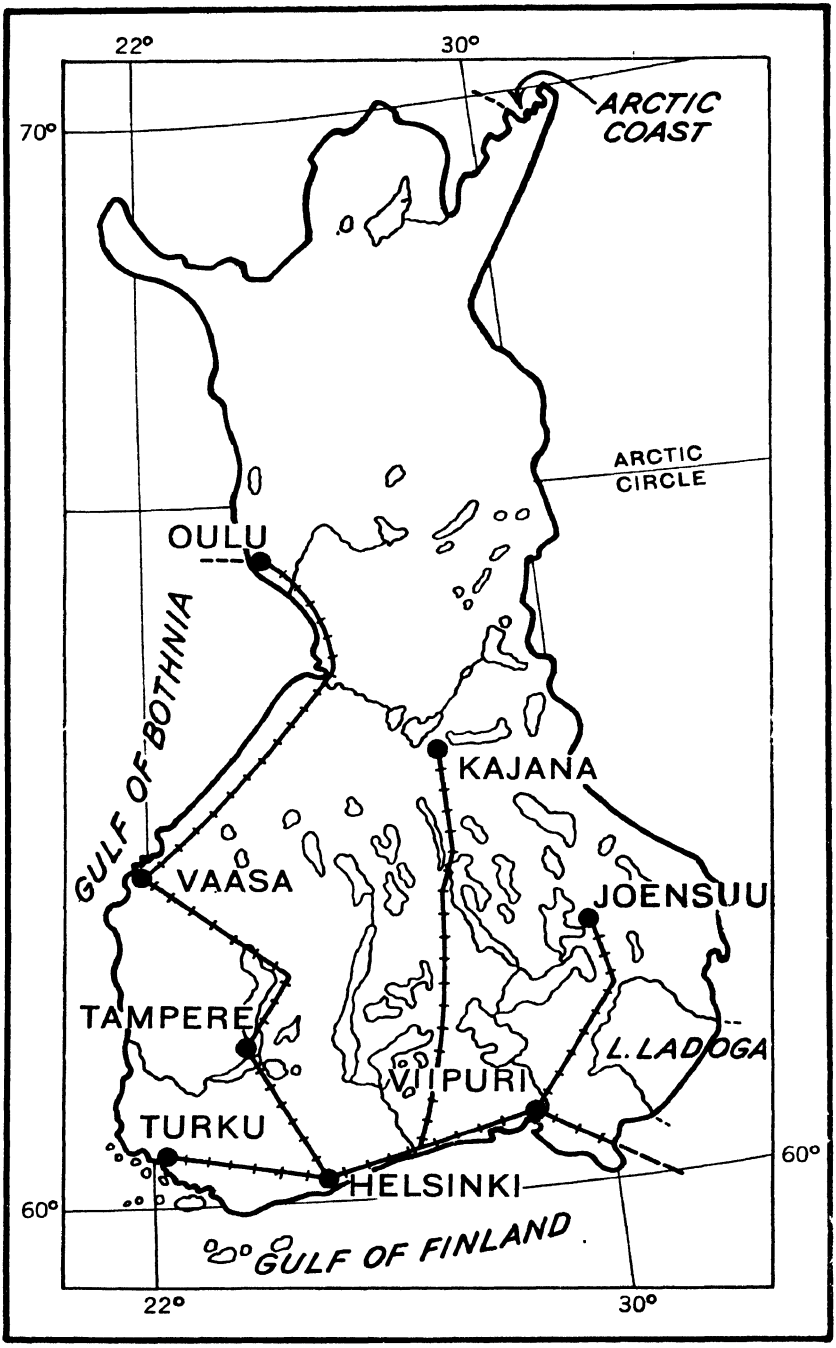


Fig. 189. Finland, with the principal lakes, cities, and railroads.

are an important article of diet, and some people think that they are eaten too much for the best health.

Agriculture. Only 7 per cent of the land area of the country is cultivated. Sixty per cent of the people farm on plots, the land having been divided in 1929 under legislation which permitted tenants to purchase land on which they worked. Farming is conducted in clearings in the forests, the most important section being in the small deciduous-tree area in the south. Half of the land under cultivation is in hay, and one sixth in oats; rye, barley, and potatoes are other leading crops. Cattle, sheep, and swine are the most numerous of the animals. Dairying has always been a leading farming activity, as is indicated by trade records of the Middle Ages which give butter as the main export of Finland.

Coöperative marketing is an important factor in Finnish agriculture, as it is in the agriculture of all the Baltic countries. Depending much on outside markets and being compelled to compete with other countries, which can be done only on a basis of quality, Finland needs dependable standards of quality. Experience has taught that these may be attained best by coöperative methods.

Manufactures. The leading manufacturing industries of Finland are paper and pulp, lumber and its products, iron and steel, and textiles. Tammerfors, with a moist climate, water power, and a good harbor for importing, is a cotton-manufacturing city. Turku is a shipbuilding center.

Foreign commerce. Forest products, of which 30 per cent is chemical pulp, comprise 85 per cent of the exports of Finland, followed by butter and eggs. The leading imports are iron and steel, textiles, machinery, chemicals, and coal. Half of the exports usually go to the United Kingdom, and 25 per cent of the imports are from there. The German Reich now takes about 10 per cent of the exports and supplies almost 20 per cent of the imports, and is followed by the United States and Sweden. Exports are usually about 25 per cent greater than imports.

Helsinki is the leading seaport, followed by Kotka and Viipuri.

ESTONIA, LATVIA, LITHUANIA

Geographic features. Like Finland, Estonia, Latvia, and Lith-

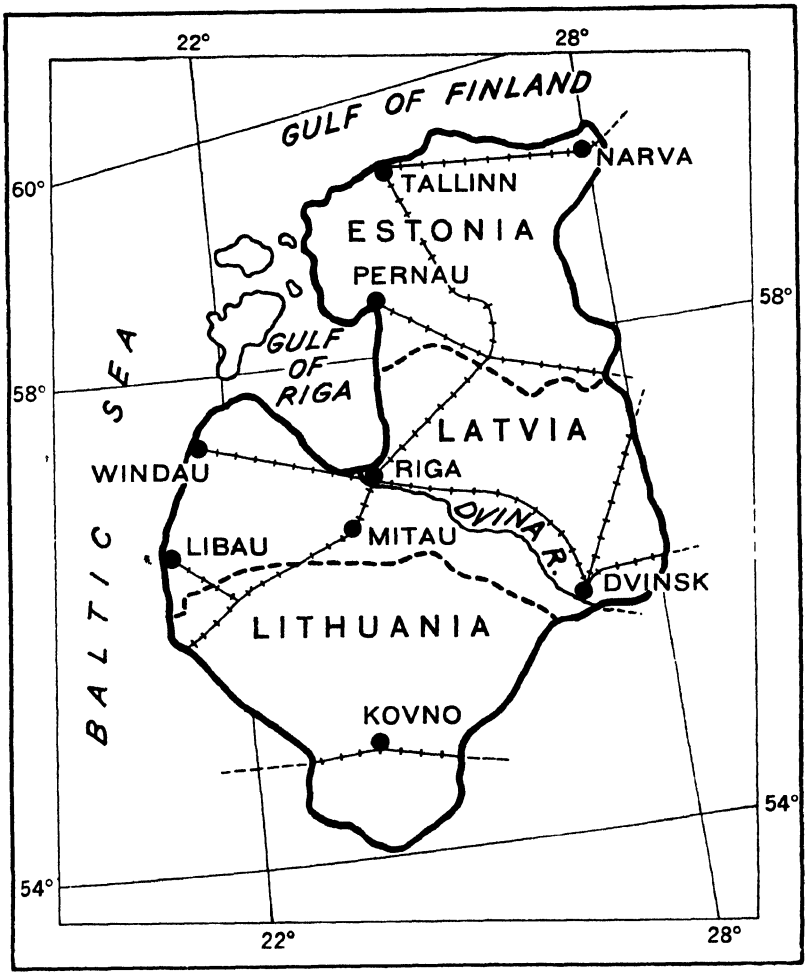


Fig. 190. The three small Baltic states with their principal cities and railroads.

uania are forested lakelands, although the lakes are not so numerous; however, almost one seventh of Estonia is a peat bog. Unlike Finland, these countries are a part of the great plain of Europe

and are covered with a thick sheet of glacial sands and clays and alluvial material.

The combined area of the three countries is 65,282 square miles, and their combined population, 5.6 million. Density ranges from 62 people per square mile in Estonia to 116 in Lithuania.

Climate. These countries have the continental type of climate with its short, warm summers and long, cold winters, but the extremes are greater than in southern Sweden, Riga having a mean January temperature of 23°, compared with 26.6° for Stockholm, and a mean July temperature of 64° compared with 62.1° for Stockholm. The July isotherm of 64°, which extends along the north coast of France and of Germany, almost bisects the area contained in these three countries. The winters are so cold that the seaports usually are blocked with ice for four or five months. Rainfall is about the same as in other parts of the Baltic region.

Natural resources. Forests and soil are the only natural resources of importance, although Estonia has oil shales and Lithuania amber. There are small amounts of water power, the most important site being near Narva. About 20 per cent of the entire region is forested, largely with deciduous trees, and about 30 per cent is included in natural meadows and pastures.

Agriculture. The dependence on agriculture for a livelihood in these countries is shown by the fact that 75 per cent of the population are farmers. Agriculture has been encouraged by direct action of government, coöperative marketing, and the breaking up of the large estates into small holdings. About half of the land of Lithuania and a quarter of that of Estonia and of Latvia are under cultivation, a large part in pasture and meadow; rye, oats, and root crops are all important. Rye bread is eaten widely because wheat does not do well on the poor soil and will not stand the severe winters. It should be noted here that root crops are relatively more important for man and beast around the Baltic Sea than anywhere else; in addition, their cultivation leaves the soil in good condition for other crops. Dairying is the leading agricultural industry, having developed rapidly since the

countries became independent, and swine and sheep are both numerous. The climate is also excellent for the growing and retting of flax, and there is cheap labor to care for the crop. All the countries grow the crop, but Lithuania is most important. Much of the fiber goes to western Belgium and to Belfast, two of the leading linen-manufacturing centers of Europe.

Manufactures. Other than the manufacture of products from the forest and the processing of agricultural products, textiles are the only important manufacture, cotton, wool, and flax all being worked. Narva, near the rapids on a river, is the principal textile center; but Riga and Kovno also have factories.

Foreign commerce. Forest products, Latvia supplying two thirds, and butter, are each about 20 per cent of the combined exports of these three states, and flax and pork are each about 7 per cent. Textiles, raw cotton, iron and steel, machinery, coal, sugar, and fertilizer are leading imports. Recently, the United Kingdom has been the market for 40 per cent of the exports and the German Reich for about 25 per cent, and each has supplied about 25 per cent of the imports.

Reval, on an excellent harbor which freezes only occasionally, is the only important seaport in Estonia. In Latvia, Riga, Windau, and Libau are all important, shipping much Russian as well as Latvian produce. Three main routes of Russia converge on Latvia, and at one time Riga was the third ranking port of the Russian Empire. Since 1920, these ports have not been used much, partly because of the upsetting of the previous industrial and trade relations by the change in political and economic policies. Riga is also connected with western Europe by railways of a gauge similar to that prevailing in western Europe. Libau occasionally remains ice free during the winter, but ice breakers are necessary to keep Riga open to ships during the winter. Lithuania has access to the German port of Memel and is on through routes between eastern and western Europe and therefore shares in the movement of international traffic.

Future of these countries. The future of the countries discussed in this chapter depends much upon the human factor. The long period of foreign domination, with the foreigners assuming the leadership and the more responsible positions, has left the people largely without the necessary experience for governing themselves and for conducting large industrial enterprises. Another problem is the great dependence on foreign markets and on a limited number of products in all of the countries except Poland, a condition which does not make for economic stability. Much has been done to diversify economic activities, but the four smaller states are limited largely to forest industries and agriculture. Finally, conquest by strong and willing nations does not seem to have passed into history. Located strategically between strong and antagonistic countries, these Baltic states may suffer from foreign domination in the future as they have in the past.

34

THE HIGHLAND COUNTRIES OF CENTRAL EUROPE

THE highland countries of central Europe (Switzerland and Bohemia, Moravia, and Slovakia, three German protectorates) are included largely in the Alps and Carpathian ranges of mountains and the mountain-girted plateau of Bohemia. In these countries are several strategic natural routes between north and south Europe, with attendant economic and political implications. The Moravian gateway, connecting the valleys of the Oder and the Danube, is of especial military significance and is also an important route for the exchange of goods between the Baltic and the Danube regions. More important economically, however, are the natural routes of Switzerland, which are the valleys of the rivers that have their sources in the Alps, and the mountain passes. The St. Gotthard and the Simplon, the most important passes, have tunnels through the mountains beneath them. The control of natural routes gives Switzerland transit trade, from which its industries benefit much.

The population of Switzerland is 70 per cent German, 21 per cent French, and the rest largely Italian; that of Bohemia and Moravia is largely Czech, and that of Slovakia, Slovene, with small proportions of Germans and others in the three. In spite of differences in nationality, speech, and religion, the Swiss live peacefully, liberal political ideals being a common bond.

SWITZERLAND

Geographic features. Switzerland, containing 15,944 square miles of territory and slightly over four million people, is double

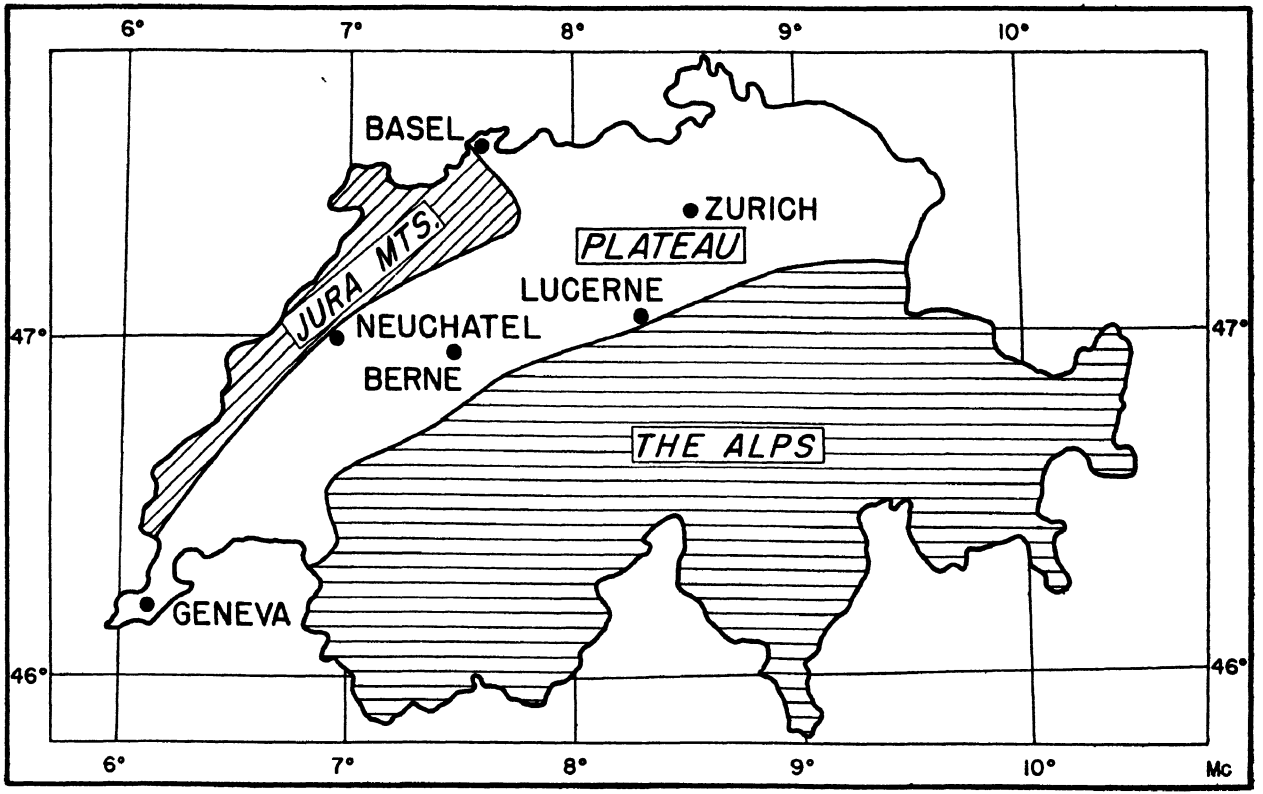


Fig. 191. Natural divisions and leading cities of Switzerland.

the size of Massachusetts but has only an equal population. There are three natural regions: (1) the Alps, which cover two thirds of the area, (2) the Juras, a small area in the northwest, and (3) the intervening rough plateau, which contains nearly all the people and industries. The Alps, with much forest and pasture land, are cool and moist, and have glaciers, lakes. and snowfields to create water power. The Juras consist of parallel ranges of folded limestone, with eroded tops. They have a severe climate and poor soil, but enough moisture to make good pastures. Farming, forestry, and grazing prevail throughout them, although there are a few rather barren spots owing to porosity of the underlying limestone. The plateau has a few fertile spots, but its soil, eroded largely from sandstone, is poor. The altitude of the plateau varies from one to three thousand feet, and in some places it is almost mountainous.

Forests. About a quarter of the total area of Switzerland is in forests, which have an important place in the economic life of the people; and a law of 1876 forbids reduction of the area at any time. In addition to providing lumber, the forests are necessary to protect the agricultural land of the valleys from floods. Conifers predominate, but on the plateau most of the trees are beech; and in the southern valleys oak and chestnut predominate. The forests are publicly owned and are scientifically cared for, having the appearance of well-kept groves. In spite of the attention given the industry, lumber must be imported.

Minerals. Switzerland is almost devoid of mineral wealth. Recently seemingly important deposits of iron ore have been discovered in the Canton of Aargau, and small amounts of iron ore and manganese are mined in St. Gall. Salt is also an important product.

Water power. Water power is Switzerland's most important natural resource. The potential amount (two and a half million horsepower) is about equal to that of New York State, and most of it has been developed. Hydroelectric energy is used much in transportation, in manufacturing, and on the farms.

Agriculture. Only 12 per cent of Switzerland is arable land; consequently, and also because of the cool climate and rather heavy rainfall, the range of crops that can be grown is limited. Crop production is chiefly in the plateau but also on southern slopes and in protected valleys, some of the southward-facing valleys growing olives and other subtropical crops. The same crops prevail as in the Baltic area, with the addition of grapes and a few of the middle-latitude tree fruits. Apples are important, and a considerable amount of cider is exported.

Grazing. Poor soil, ruggedness, and a cool, moist climate make nearly all the productive land grassy; animal industries, therefore, are important. Cattle and goats are numerous, the former being most important in the plateau, the latter in the poorer grazing land of the Alps. Although there are many beef animals, the country is famous for its dairy industry and markets several famous brands of cheese, among which are Emmenthaler, Gruyere, and Spalen. The majority of farms do not have more than two or three cows each. The larger herds are in the more mountainous districts and are those which are driven to the high alps in the summer and taken back to the valleys during the winter months. A part of the family remains in the high pastures with the herd, and other members go up periodically from the valley to take the products back. Half of the milk is consumed within the country, and butter is even imported from Denmark and condensed milk from the United States. The other half of the milk produced is made into cheese, milk chocolate, and condensed milk. Bern and Neuchâtel are centers for the manufacture of dairy products, and the Canton of Vaud for milk chocolate.

Manufactures. Switzerland is essentially a manufacturing country, only 28 per cent of the people being engaged in agriculture. It is famous for the high quality of its products, a result of the scarcity of fuel and of raw materials. Water power takes the place of coal, but the raw materials must be imported and a large proportion of the finished products exported, and only goods of high value can bear the freight charges. It is in this

connection that the transit trade of Switzerland is important, because the added volume helps to reduce the unit cost of operating the railways, making the imports of foods and raw materials cost less than otherwise would be the case. Switzerland may be said to export labor, its leading industrial resource, the labor being embodied in the quality of the goods. Long years of experience and the attention given to technical education in the country influence the quality, and a superior type of product must be made in order for the country to compete with those with more favorable conditions for manufacturing.

A large number of Swiss manufactures were originally home industries that worked up local supplies of surplus material and provided an outlet for the idle time of the people. It has been only recently that most of them have left the houses for the factories. There is still considerable manufacture in the homes; some of this, however, is work that is done under an agreement with the factories.

The manufacture of watches is the industry for which Switzerland has always been most famous. Handmade watches have always predominated, but now there is some standardization of parts, and the work is done in factories. The industry is concentrated along the base of the Juras between Geneva and Solothurn and beyond. Clocks and jewelry are also made in the same area.

The manufacture of textiles, cotton and silk being of equal importance, is the leading industry, and is located mainly along the base of the Alps. Zurich is a center for both products. Basel has the largest ribbon mill in the world, the ribbon being exported largely to Great Britain. The Canton of St. Gall is noted for embroidery work, but the industry has declined, employing only 2,000 people, compared with 23,000 in 1918. The growing rayon industry is located around Emmenbrucke.

The manufacture of machinery, especially electrical equipment, but also textile and agricultural machinery and metal articles, is almost as important as that of either textiles or watches; com

bined, these products rank first among the exports. Zurich is the center of machine manufacture. Because of the water power, Switzerland is important in the smelting of aluminum and the manufacture of chemicals, for which Basel is a chief center. Geneva is outstanding in making scientific instruments.

The tourist industry. Cool summer climate, facilities for winter sports, scenery, central location and easy access from the countries with the greatest per capita wealth, and the friendliness of the Swiss people have combined to make Switzerland one of the

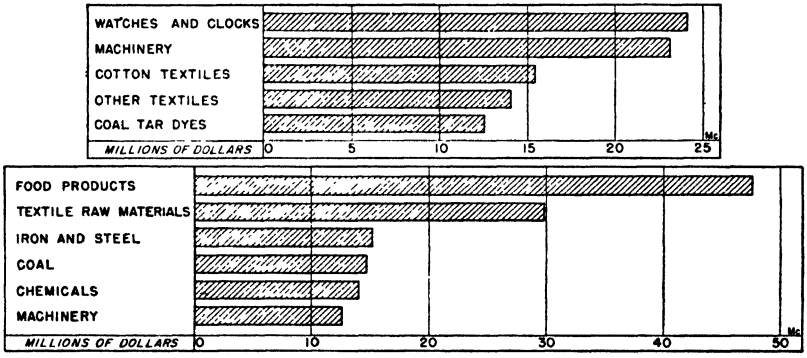


Fig. 192. Principal items in the foreign commerce of Switzerland in 1935; exports above, imports below.

most favored tourist centers of the world. Normally there are more than two million visitors annually, a large proportion being German. These tourists spend about $250,000,000 within the country. There are about 8,000 hotels, with a personnel of 62,000 people, representing an investment of $400,000,000.

Foreign commerce. Switzerland depends much upon foreign commerce and has a per capita foreign trade which is among the highest of the world. The imports, which are considerably more than the exports, are balanced by tourist expenditures, transit trade, and interest payments on foreign investments. Recently the German Reich has purchased about 25 per cent of the exports and has supplied almost 30 per cent of the imports. France has shared 15 per cent of each, followed by the United Kingdom and the United States.

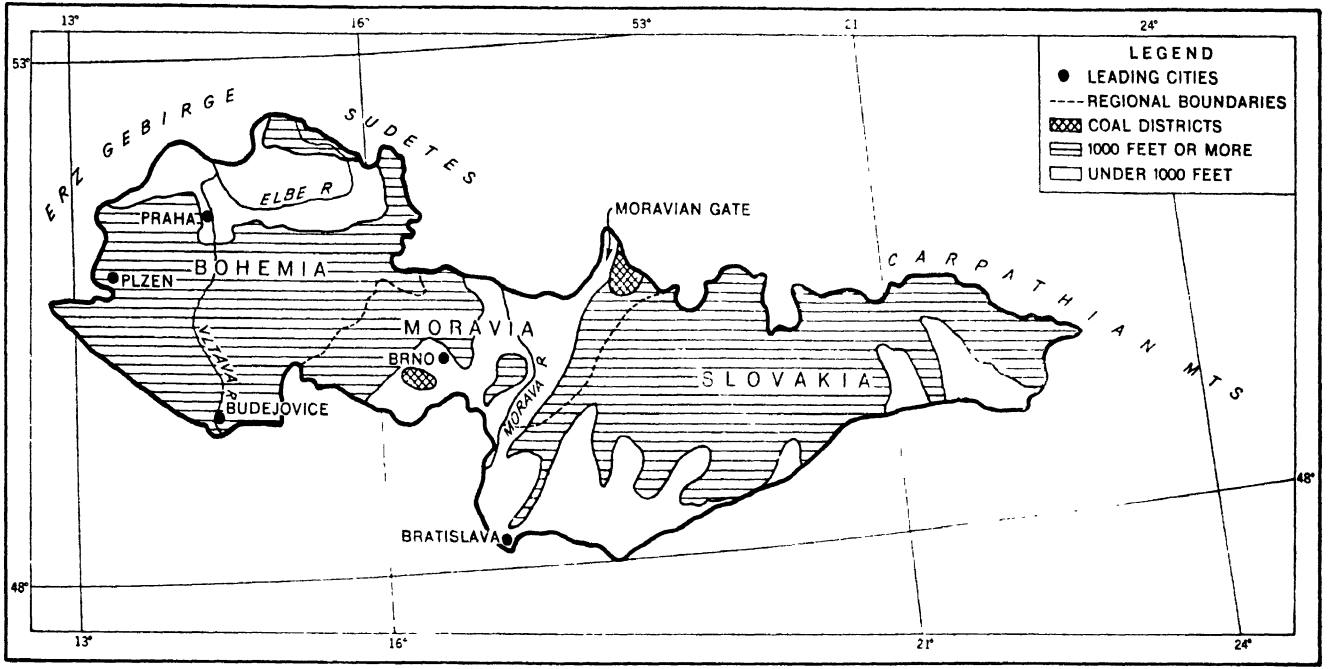


Fig. 193 Bohemia, Moravia, and Slovakia.

BOHEMIA, MORAVIA, AND SLOVAKIA

The principal advantages possessed by these protectorates of Germany are energetic and progressive people, moderate forest resources, fertile soil, and a moderately good location for conducting foreign trade. The only minerals of importance are large reserves of graphite in western Moravia and magnesite in the Carpathian district. There are scattered deposits of coal and lignite and of a few other minerals.

The climate of this region is the continental type which prevails over central Europe; the southern location, however, makes some sections hot enough in summer to grow corn and grapes.

These three countries have an area of 32,000 square miles and a population of a little more than 9 million, the density of population being about 290 per square mile.

Agriculture. About 43 per cent of the total population is engaged in agriculture. Methods and crops are much like those of Germany except that rye is relatively much less important. Rye and wheat each occupies one sixth of the land in cultivated crops, and oats, potatoes, legumes, and barley each roughly one seventh. Small holdings prevail, the large estates formerly held by the Austrian aristocracy having been broken up into peasant holdings by legislation in 1924. In Bohemia crops which require fertile soil are grown along the river valleys and in the north, and rye, potatoes, and pasture grass are grown on the poorer soils of the south. Root crops are important. Potatoes are the base for a distilling industry and are an important export, and there is an annual output of more than 4 million tons of beet sugar. Hops are grown and are exported to Germany.

Animal industries are important, 50 per cent of the total number of livestock being cattle and 25 per cent swine. There is also a large number of goats, which provide the base for a glove-manufacturing industry. Dairying is important and is increasing.

Manufactures. Small resources of coal and water power, forests, and cheap labor provide the basis for some manufacturing in

Bohemia and Moravia, while location is favorable for shipping manufactured goods to overland markets in a wide area to the southeast, where manufacturing is unimportant. Relatively new factories operated by the most modern methods are a further advantage.

The principal industries are the manufacture of iron and steel, machinery and munitions, furniture and paper, glass and pottery, chemicals, liquors, leather products, textiles, the refining of sugar, and the processing of a number of agricultural commodities.

Praha, Plzen, and Brno are iron and steel centers, and the last is an important producer of machinery. At Plzen is located a world-famous munitions factory, and both Plzen and Budejovice have a world-wide reputation for beer. Moravská Ostrava and Kladno also have munitions factories. Paper is manufactured at Praha and at Plzen, pottery at Praha, and pottery, glass, and chemicals at various points along the Elbe Valley. Bohemia is one of the leading European manufacturers of leather products, having the largest shoe-manufacturing company on the Continent. A small production of cotton textiles is scattered in Bohemia, and Brno is an important wool-manufacturing center. The leading industrial centers are Praha and Plzen; both have factories in several industries in their vicinity.

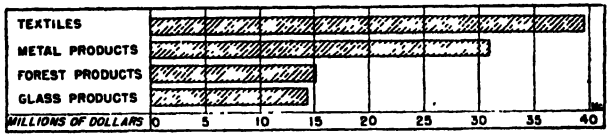


Fig. 194. Principal exports of Czecho-Slovakia in 1935.

Foreign commerce. Before these countries became protectorates of the German Reich, about 25 per cent of both the importing and exporting had been with the German Reich. The United Kingdom, the United States, and France have been of equal importance, but far less important than the German Reich.

With the establishment of protectorates over these countries by Germany, that country will have obtained control over supplies

of timber and agricultural and animal products, all of which have been important imports into Germany and which have been important exports from these countries. Even before political control by Germany large quantities of these products were sold there, but now the amounts will probably increase.

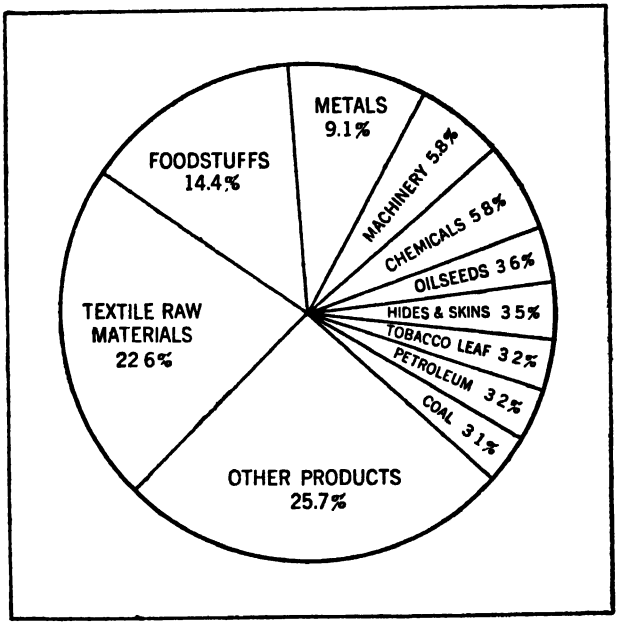


Fig. 195. Relative values of the imports of Czecho-Slovakia (boundaries as of 1936) in 1936.

The bulk of the foreign trade moves by rail, following the Elbe Valley. Products moving by the Elbe use the port of Aussig, which is being connected with the Danube by a canal. Bratislava, the port on the Danube, has recently been enlarged and improved. The leading waterway in tonnage carried is the Vltava.

35

THE AGRICULTURAL COUNTRIES OF SOUTHEASTERN EUROPE

THE countries included in this chapter—Hungary, Rumania, Yugoslavia, Bulgaria, Greece, Albania, European Turkey—have common features that justify their discussion in a single chapter. Agriculture is the predominant occupation, and, with the exception of Hungary, where methods are similar to those of our corn belt, the industry may be characterized as unprogressive. These are agricultural surplus countries, depending on export markets both among themselves and with industrialized Europe. There are other common features discussed in the following section.

Historical factors. With the exception of Hungary, these countries are commonly known as the Balkans, and the entire region has had a long and disturbed history. Because of the location and topography, the region has been a fighting ground for centuries. Located on the threshold of Asia and on several natural routes, it is easily accessible to that continent. The Maritsa and the Morava-Vardar Valleys give access from the south. The Iron Gate makes it possible for invaders coming through the Maritsa Valley or across the Russian and Rumanian plains to get to the Hungarian plain; the Moravian gateway to the north provides an easy route to this plain from Russia westward along the north base of the Carpathians. Successive waves of invaders from various directions have provided a basis for the different racial groups and religious beliefs that prevail. And invasion may not be a matter of the past, for the location is such that stronger countries may utilize the region to realize their dreams of empire.

Although important world routes go through this region, the

topography is so complicated that many groups of people have become isolated, with intense economic and political rivalry resulting between states and groups.

Transportation, in conjunction with dependence on outside



Fig. 196. Southeastern Europe.

markets, has also been a disturbing influence. The leading exports are relatively bulky, cheap products, most of which must go down the Danube, which is about the only centralizing influence in the entire region; the outlet for the exports thus is roundabout. This transportation problem causes rivalry for acquisition of

favorably located seacoasts and ports. Even then it is relatively easy, in case of war, for the whole region to be shut out of world markets.

Area and population. These countries are about 40 per cent larger than the German Reich, and they have about 60 per cent as many people. The density ranges from 95 people per square mile in Albania (double that of the United States) to 249 in Hungary. Rumania contains one third of both the population and the area, and Yugoslavia a quarter of each.

Geographic features. Two natural divisions may be recognized: the plains of the Danube, consisting of the Hungarian plain, formerly the location of an inland sea, and the Rumanian plain, an extension of the plain of Russia; and the southern highlands, which consist of three parts, the Balkan Mountains, the Dinaric Alps—Pindus range, and the Rhodope Mountains, together with intervening valleys and small coastal plains. The Balkan Mountains are folded and are continuous with the Carpathians, after they cross the Danube at the Iron Gate. The Dinaric Alps and Pindus Mountains are also folded and are composed of porous limestone, which makes much of the region barren. The Rhodopes, similar geologically to the Bohemian plateau, are separated from the Balkans by the Maritsa Valley and from the Dinaric Alps by the Vardar Valley.

Climate. Differences in location, topography, and exposure cause considerable climatic diversity. In the west and south, Mediterranean conditions are approached, and the Dalmatian coast, Albania, Greece, and protected parts of eastern and southern Bulgaria do have the Mediterranean type of climate. Elsewhere, winter temperatures are similar to those of the countries to the north, but summer temperatures are more similar to those of the Mediterranean region. Relatively less of the rain falls during the cool months than in Germany or Poland, which is an advantage because of the higher summer temperatures. Position on the leeward side of the mountains and near Russia, with its extreme continental conditions, causes the climate to be more variable than

in the Baltic region. Cold northeast winds from Russia cause cold winters in Rumania, Hungary, and eastern Bulgaria, and cold winds also descend from the highlands to the plains. In

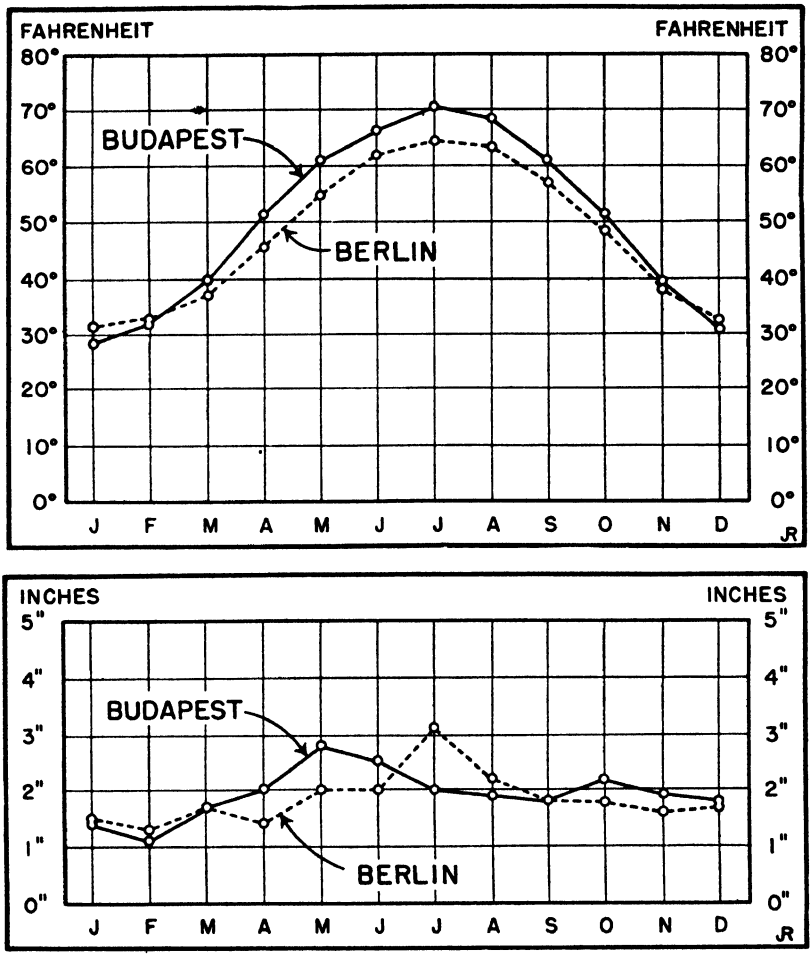


Fig. 197. Mean monthly temperatures and monthly rainfall of Budapest and Berlin; temperature above, rainfall below.

winter most places in the Danube Valley above 2,000 feet are covered with snow. Rainfall is heaviest along the Adriatic coast, gradually decreasing eastward except where mountains are encountered.

The Danube. Since several of these countries depend much upon the Danube for transportation, a brief description of that river will be given. One of the important navigable rivers of the world, it has three capital cities along its course and others near by, and handles about 20 per cent as much traffic as the Rhine. The volume of water is the greatest of any European river, for there are 500 tributaries, 60 of them navigable; the volume becomes great after the Inn, which is larger than the Danube where the two meet, empties into it. Varying depth, rapids, floods, ice and fog, and silting of the mouth are handicaps; the delta has been extended 10 miles since the days of the Roman Empire.

Braila and Galatz are the leading ports, the former accommodating vessels of 4,000 tons' capacity and 21 feet in draught. Vessels drawing 8 feet of water can go to the Iron Gate, and smaller steamers to Ratisbon. Two-foot barges can go as far as Passau, where the Inn enters, and flat-bottom boats of 100 tons' capacity to Ulm, which is usually considered the head of navigation. Pest is the most modern of the ports, and much shipping concentrates there.

Forests. Certain of the natural resources and industries can best be discussed for this group of countries as a unit; others are left until the treatment of the individual countries.

Forests are not important in Hungary or in the sections with a Mediterranean climate. About a quarter of Rumania and a third of both Yugoslavia and Bulgaria are, however, in forests, with beech and oak predominating in the lower, warmer locations and fir in the cool highlands. Forestry and lumbering are inefficiently organized and conducted, and the latter labors under the difficulty of inaccessibility and the lack of good water transportation for marketing. Locally, the markets can be reached because of the lack of outside competition, but these countries cannot compete in world markets with the lumber-exporting Baltic states. In addition to providing fuel, lumber, and wood for woodworking industries and pulp and paper factories, both for domestic

use and for export, the forests supply acorns and other nuts, which are used as feed for a large number of swine.

Minerals. Although these countries are not significant for their mineral wealth, the mountainous areas, chiefly around the edges of the basins, and the igneous intrusions in the plain, contain deposits, some of which are of considerable size. The Bihar district of Hungary has deposits of bauxite, which are thought to be among the largest in the world. Rumania has long been an important petroleum-producing country, and recent prospecting indicates that petroleum may occur quite extensively in some of the other countries. Yugoslavia, Bulgaria, and Greece each contains deposits of several minerals, among which are bauxite, chromite, lead, iron ore, zinc, emery, copper, and pyrites. Bulgaria

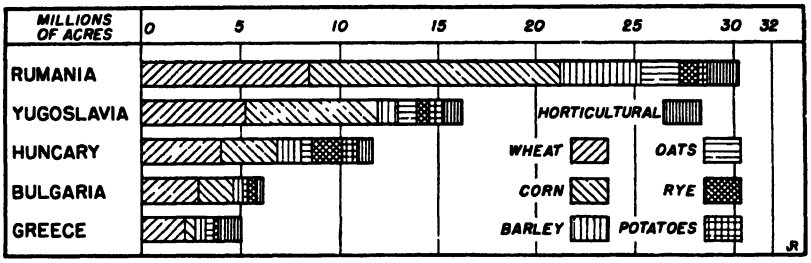


Fig. 198. Acreages in the principal crops of the countries of Southeastern Europe in 1935.

is also thought to contain moderately important reserves of coal. Expensive transportation and the scarcity of fuel have prevented extensive exploitation of the mineral supplies of these countries.

Agriculture. Sixty per cent of the people of Hungary and eighty per cent of those of the remaining countries are engaged in agriculture. In all countries except Hungary methods are antiquated and poor; the persistence of customs and habits is striking, and it is said to be almost impossible to change the methods through teaching. A stagnating influence is the excessive number of holidays, many of them religious, a large number occurring at seeding and harvest time. The lack of capital and

the burden of heavy taxes in some places are other obstacles. Another difficulty in Rumania, and in some other parts of Europe as well, since the War, results from measures of land reform which broke up large estates and placed the land in the hands of the peasants, a large percentage of whom are ignorant and unprogressive. Millions of acres were thus removed from the superior production methods of the large estates to poorly directed peasant control. The region provides a surplus of both cereals and animal products. The distribution of the various crops and animals among the different countries is given in Figures 198 and 199.

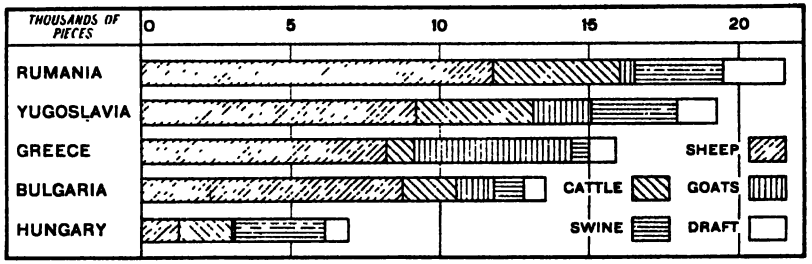


Fig. 199. Numbers of various animals in the countries of southeastern Europe in 1935

HUNGARY

Agriculture. Hungary is largely a low flat plain of fertile soil and, within its present boundaries, must always remain an agricultural country. Important crops other than those given in Figure 198 are sugar beets and tobacco. The production of beet sugar is normally slightly more than one million tons. Hungary ranks after the U. S. S. R. and Greece, among European countries, in the growing of tobacco. Half a million acres are in grapes around Tokay, the home of a wine by that name, and to the north of Lake Balaton. The vineyards are on volcanic soils, which occur in spots where the plain abuts on the highlands. Orchards are also set on these volcanic soils and on sandy soils. Hungary also raises horses, many for export, and Debrecen is a great horse market.

Manufactures. Flour milling and sugar refining are the leading manufacturing industries of Hungary. Budapest, with large flour mills, is the leading flour-milling city of Europe; it was here that the gradual-reduction process for milling was first developed.

Exports. The volume of foreign trade, the imports, and the distribution of the trade are discussed for this group of countries at the end of this chapter; in the discussion of the individual countries only the exports will be given.

In 1935 animal products accounted for 33 per cent of the exports of Hungary, cereals 15 per cent, and iron and steel and machinery 15 per cent. From small reserves of coal and iron ore Hungary has recently developed an iron and steel industry, and supplies products to neighboring countries.

RUMANIA

Agriculture. Rumania consists of parts of the Russian and Hungarian plains, a large part of the Carpathians with their plateaus and foothills, and the partly swampy, partly semiarid Dobrudja, which is fit for little but grazing. Almost half of the area is arable; the mountains have extensive forests and pasture lands, and their foothills forests, minerals, and fertile protected valleys. The Arges and Jalomita basins near Bucharest are among the most fertile spots of the country. Crops other than those given in Figure 198 are rice, flax, sunflower, mulberry trees and silk cocoons, sugar beets, and tobacco. Two per cent of the area of the country is in horticultural products, the Buzen basin being particularly noted for them. Wheat is grown chiefly on large holdings in the plain, while corn is typically a crop of the small operator of the highlands. Transylvania, the basin enclosed by mountains in the west-central part, is a horse-raising section.

Manufactures. Although the variety of raw materials and water power in the Carpathians provide a basis for some complex manufacturing, the processing of agricultural products, the milling of lumber, and the refining of oil are most important. Bucharest, Braila, and Galatz are flour-milling centers, and the

former two have breweries and paper and woolen mills, and Braila has rice mills. There are silk factories in the Prahavo Valley, which also has oil refineries, tanneries, and chemical factories, the salt deposits making possible the latter. Ploesti is an important oil-refining and chemical center. Galatz has large sawmills.

Exports. The economic life of Rumania depends upon petroleum, cereals, and products of the forest; in 1935 petroleum supplied half of the exports, cereals 20 per cent, and forest products 9 per cent.

Seventy-five per cent of the exports and 65 per cent of the imports move by the Danube. Braila, Galatz, and Constanta handle the bulk of the trade. Braila is largely an export point; imports are relatively more important at Galatz. Constanta, where an outcrop of hard rock provides a base for a city, is a year-round port, receiving traffic overland when the Danube is frozen. It moves much petroleum and grain, having the best facilities for the latter of any city in the country. It is connected with Bucharest by a railway that crosses the Danube at Cerna-Vodă, where the only bridge over the lower Danube is located.

BULGARIA

Agriculture. Bulgaria is composed of a number of river valleys and basins separated by mountain ranges. The Balkan foreland and the Maritsa basin are the most fertile sections, the former being the leading agricultural district. It is a sloping area of porous limestone with considerable oak and beech on its lower slopes and grows wheat on the drier soils and corn in the moister valleys. The small Inter-Balkan range divides the Maritsa basin into two parts. The northern part, with its many protected valleys on the south side of the Balkans, is one of the garden spots of the Danube region. In addition to the crops shown in Figure 198, rice, tobacco, and mulberry trees are grown. Kyustendil is a great horticultural center. Tobacco is grown along the Rumanian border and in valleys in the south; some of the former

tobacco lands of Turkey were acquired after the War. Poultry raising is important, and eggs are exported in large quantities. Ruggedness and dry climate make sheep and goats particularly important.

Manufactures. Manufacturing is only slightly developed in Bulgaria, and home industries predominate. Various agricultural products are processed, and there are small metal industries and a developing textile industry at Varna. Near the Shipka Pass, the most important pass through the Balkan Mountains, is the famous Vale of Roses, where *attar of roses,* an expensive perfume, is made. The petals of the damask rose, which is grown for the purpose, are gathered and pressed between layers of cloth saturated with lard. The lard absorbs the essential oil, from which it is later separated.

Exports. In 1935 tobacco comprised 40 per cent of the exports of Bulgaria, eggs 12 per cent, and grapes 8 per cent.

Varna is the leading port on the Black Sea but has much competition from Burgas; both are relatively more important for exports than for imports. More than half of the imports enter through the Danube port of Russe. On the Aegean Sea, Kavala and Alexandroupolis (used by agreement with Greece) handle Bulgarian trade.

YUGOSLAVIA

Agriculture. Yugoslavia is mountainous except for the fertile river plain in the northeast. Potentially it is a rich country, with fertile soil, forests, minerals, and water power. About 56 per cent of the total area is cultivated. Crops other than those shown in Figure 198 are hemp, tobacco, and the prune plum. Yugoslavia, foremost in the production of prunes until displaced by California, has recently expanded this industry, and is now a serious competitor of the United States in the markets of Europe. There are 60 million plum trees. With corn and oak and beech forests, there are opportunities for the production of swine, but the industry is retarded because drought makes the corn crop un-

certain, and because of contagious diseases. Poor sanitation and the ignorance of the peasants concerning infectious diseases among swine contribute to the retardation of the industry. The British, recognizing the possibilities for swine, have recently tried to encourage the industry by establishing packing plants.

Manufactures. Flour milling is the most important manufacturing industry, Batchka being the main center. At Pinot, carpets are woven from pure wool and dyed with natural colors; the formulas for the dyes are a secret passed from father to son. Textile manufactures are increasing, the smelting and refining of metals is important, and there are leather, pottery, and pulp and paper industries, brewing and distilling, and other industries.

Exports. In 1935 animal products contributed 33 per cent of the total exports, forest products 20 per cent, and cereals and minerals each 10 per cent.

Much of the foreign commerce goes through various ports along the Danube. Under the provisions of a treaty with Greece in 1923, Yugoslavia has for fifty years a free zone in Salonika; Fiume, in Italy, is also used. On the Adriatic are Split and Dubrovnik; the former has the best harbor on the Dalmatian coast. Although this coast possesses several good harbors, they are undeveloped because mountain ranges which extend parallel with the coast make connection with the interior almost impossible. The climate and scenery of this coast have made possible the development of a tourist industry which competes with that of the Riviera.

ALBANIA

Albania, a mountainous country of stony karstlands inhabited by wild Moslem tribes in a state of primitive economic development, is subject to the political control of Italy because of its strategic location at the entrance to the Adriatic. Although there are fertile areas of lowland, much of the land is unfit for agriculture. Even the fertile lowlands, chiefly along the coast, are swampy and not well suited for cultivation, but they are used to

some extent for winter pastures. The herding of cattle and sheep is the leading occupation. Some corn, tobacco, olive oil, and poultry products are produced on the uplands. There is a small export of tobacco and animal and poultry products, chiefly to Italy. Products are brought to market largely by donkey or by human carrier.

Forest resources and some minerals are found in the interior, but additional transportation facilities are necessary for their exploitation. A short railway has been built inland from Durazzo, which is a fully equipped port. Italy has recently supplied funds for the purposes of economic development.

GREECE

Agriculture. Only 16 per cent of Greece is under cultivation; ruggedness and dryness, which results from light rainfall, high temperatures, and porosity of underlying limestone, make most of the remainder unfit for crops. Irrigation, notably successful where applied, is restricted by lack of water supply. About 326,000 acres of cultivable land are being added by draining the Vardar marshes; the draining of Lake Copias added 53,000 acres. The plains of Thessaly and of Macedonia and some of the islands[1] are the principal agricultural sections, the plain of Thessaly being most important. The acreages of principal crops are shown in Figure 198. All of the Mediterranean crops and tobacco are also grown. Turkish tobacco is one of the main crops, and Greece has a greater acreage of it than the other countries of this chapter combined; it leads the world in the growing of the Turkish variety. The crop is grown chiefly around Cavalla and Xanthi in Macedonia, where the soil and climate are peculiarly adapted to it, and it is also an important crop in Thessaly. Currants, an important export and another crop in which Greece leads the world, are from grapes grown mainly along the southern and western shores of the peninsula of Morea. The Aegean Islands are famous for table grapes and also produce the seedless sultana

[1] One sixth of the total area of Greece is island.

currants. The grazing of sheep and goats is important in the mountains. Although agriculture and herding are conducted much as they were centuries ago, interest in improving the methods of the former has been shown.

Manufactures. Manufacturing has recently made considerable progress in Greece. Although coal may be obtained easily by water, the scarcity of both coal and water power sets limits to the expansion of manufacturing. Besides the processing of food products, the manufacture of textiles and the tanning of leather are the most important industries. Other manufactures are chemicals, soap, liquors, paper, cigarettes, and machinery. Peiraeus has cotton factories and engineering works.

Exports. In 1935 tobacco comprised 50 per cent of the exports, currants and raisins 20 per cent, and olives and olive oil 10 per cent. One fourth of the exported tobacco was sold to the United States. Exports are normally much less than imports and are balanced by emigrant remittances, tourist expenditures, and payments to Greek shipowners and merchants. Greek shipowners and merchants have long been important in the commerce of the eastern Mediterranean. In early Greece the small areas of plain, isolated from each other by mountain barriers, gave rise to separate states, between which communication had to be by sea. The experience in navigation thus gained, together with good harbors and good commercial location, led to the gradual expansion of Greek influence throughout the Mediterranean-Black Sea area.

Salonika, which commands the Vardar-Morava route through Yugoslavia and thus handles much commerce from that country, is the leading seaport of Greece. Peiraeus handles half of the imports but does little exporting because of its small hinterland. Patras is the principal export point for currants.

EUROPEAN TURKEY

European Turkey consists of a portion of the plain of Thrace that is too hot and dry for anything but grazing. Most of the people live in Istanbul, which controls the sea route between the

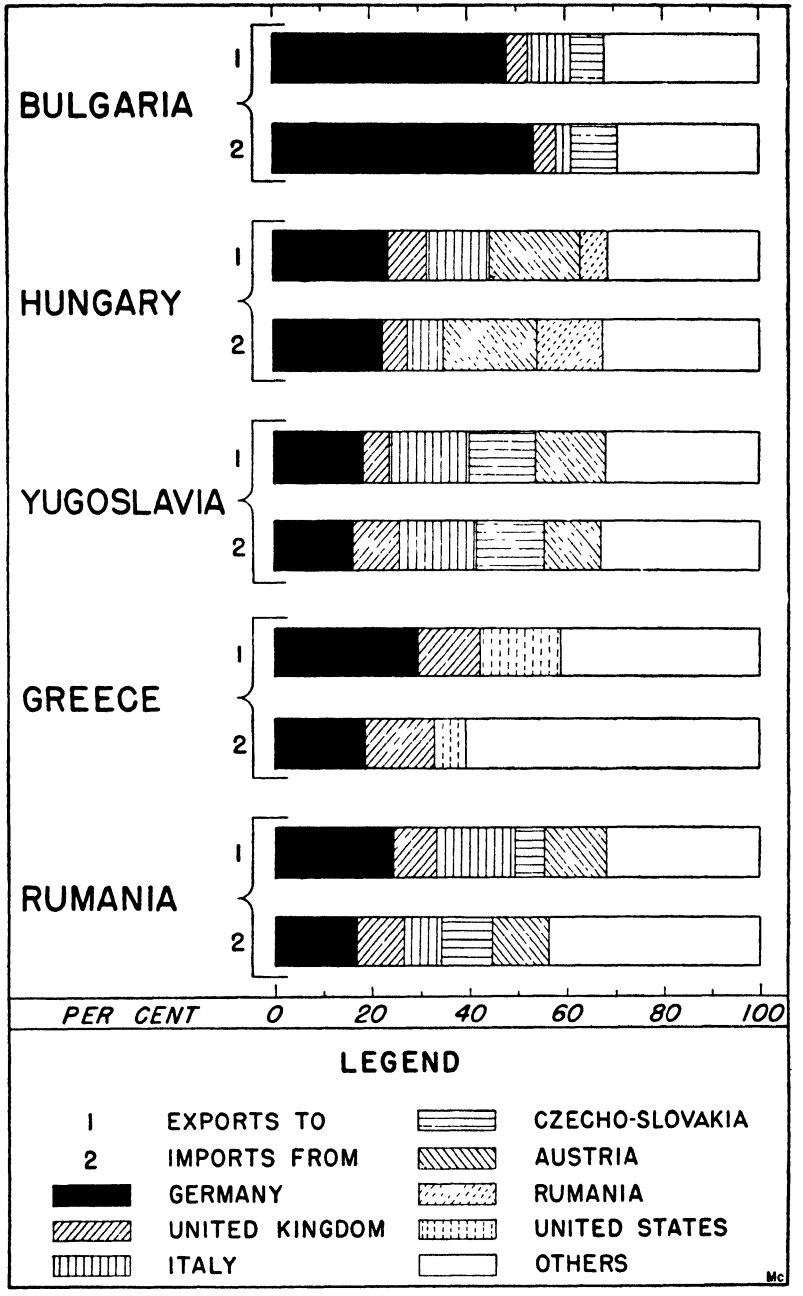


Fig. 200. Distribution of the foreign commerce of the countries of Southeastern Europe in 1935.

Mediterranean and the Black Seas and the land route that extends at right angles to the water route. This city has a fine harbor and is an important trade center.

FOREIGN COMMERCE

The discussion of this section covers the total volume of foreign commerce, the nature of the imports, and the distribution of the total foreign trade for all the countries included in this chapter except Albania and European Turkey.

Of late the total foreign commerce has been slightly in excess of $500,000,000 annually, an amount that is roughly equal to the foreign trade of Australia or Argentina. Except in Greece, the exports of each country are a little greater than the imports, the excess representing the payments of interest and principal on loans that have been granted these countries by the industrialized countries of Europe. Of the total foreign commerce, Rumania shares roughly 30 per cent, Hungary 27 per cent, Yugoslavia 19 per cent, Greece 17 per cent, and Bulgaria 7 per cent.

Except in Greece, where wheat is foremost, raw materials for the manufacture of textiles (chiefly cotton yarn) and textiles themselves comprise the most important group of imports; in Greece textiles stand second. The manufacture of textiles has been gradually expanding in all these countries, and the importing of yarn, which, because of its higher value relative to raw cotton, is more able to bear high freight charges than is the raw cotton, economizes in transportation expense. Iron and steel are second among the imports, and machinery is third. Lumber is a major import in Hungary and Greece.

The German Reich, standing first with every country of southeastern Europe in both exports and imports, controls roughly 30 per cent of the entire foreign commerce of the region; exports and imports are about evenly balanced for each country except Greece, where exports to the German Reich have recently been 60 per cent greater than have the imports from there. Italy ranks next

to the German Reich in the foreign trade of this region, and is followed by the United Kingdom.

Conclusions. The countries of southeastern Europe are primarily adapted to the production of agricultural commodities, for which great possibilities exist with more efficient methods of farming and greater political stability. Being an agricultural surplus region with only limited possibilities for manufacturing, its economic welfare depends much upon foreign commerce. Although there is a limited basis for exchange of goods within the region itself, such trade has been handicapped by protective tariffs, as it has also been handicapped in former markets outside the region. Transportation facilities in southeastern Europe are poor and outlets to the ocean are roundabout; nevertheless, location with regard to the industrial districts of central Europe is a favorable factor. The significance of relations with the German Reich, a nation without colonies and dependent upon foreign sources for foodstuffs and raw materials and upon foreign outlets for its surplus manufactures, cannot be overlooked. Increasing industrialization in Italy would probably lead to larger markets there for the region's surplus agricultural products.

36

EGYPT AND THE NEAR EAST

WE now proceed from the Balkan countries to the opposite shores of the Mediterranean, where are located several countries, now unprogressive but once the seat of empires with advanced civilizations, which long have been closely associated with the affairs of Europe. These countries are Egypt and those of the Near East (Palestine, Syria, Turkey, Iraq, Arabia, and Iran). Although these countries, largely desert, contain small productive areas and extensive deposits of some minerals, their principal importance to European countries lies in their strategic value. Egypt is important because it controls the Suez Canal route, the others because they form a great bridge between Europe and the Orient and are, therefore, important in the competition of leading European powers for political and commercial advantages.

This region is of prime importance to Great Britain because of its location along the Suez Canal route to the Orient; for this reason she has never viewed with approval the penetration into the region by other strong powers. To protect her interests, Great Britain, when giving Egypt independence, retained certain rights with regard to Egypt's international affairs and certain privileges in the Suez Canal Zone.

Area and population. Egypt contains 386,000 square miles of territory and about 15,000,000 people. The countries of the Near East are 75 per cent as large as the United States and contain almost 40 per cent as many people; Arabia comprises half of the area, Persia one third, and Turkey one sixth. Turkey and Persia each has one third of the total population and Arabia one sixth.

Density ranges from 7 persons per square mile in Arabia to 142 in Palestine.

EGYPT

The Nile. The existence of the people of Egypt depends upon the Nile, which is formed by the uniting of the White

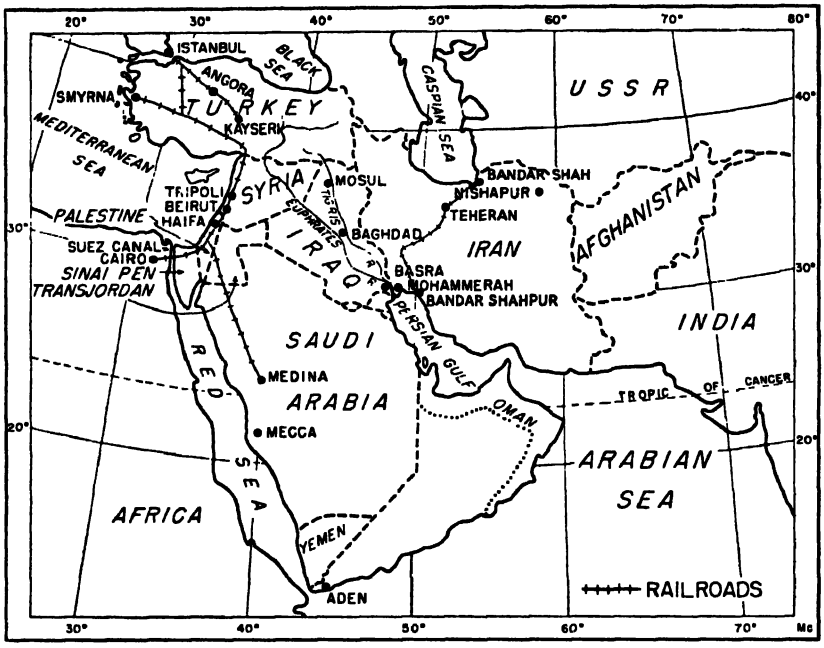


Fig. 201. Political divisions and principal cities and railroads of the Near East.

Nile and the Blue Nile at Khartoum (Fig. 156). The former has its source in the lakes of central Africa, fed by the equatorial rainfall and water from near-by snowfields; thus it has a uniform flow. The Blue Nile has its source in the highlands of Ethiopia, where elevation, monsoon conditions, and the shifting of the rainfall belts combine to cause a heavy summer rainfall. At flood stage the waters of the Blue Nile cause those of the White Nile to back up, that stream becoming sluggish and forming many swamps and lagoons. At low-water stage on the Blue Nile these

swamps and lagoons tend to drain out and thus provide more water for Egypt than would otherwise be the case.

From Aswan to the sea the river is navigable, and above Khartoum the White Nile can be navigated. But between Khartoum and Aswan are six cataracts caused by transverse ridges of hard rock, which prevent navigation except at high-water stage, when they are covered. Between the first and the last cataracts is a fall of about 1,000 feet.

Irrigation. Until recently, the Egyptians depended upon the natural overflow of the river for growing their crops, having a system called basin irrigation. Embankments were built around the fields or basins, and for two months or more water flowed from the river through canals which connected the various basins and collected to a depth of three to five feet. After the water had seeped into the land and some of the surplus had drained away, the crops were planted. Fertility was maintained by a thin coating of silt that settled on the fields during this process. Under this method the winter crop was the important one. Before the wet season the fields were baked and dry, and not much planting could be done during the flood season.

Recently, the building of dams, which make canal or perennial irrigation possible, has increased the productivity of the land, because, since the country is warm, crops may be grown the year round. The summer season, the most productive of the seasons, may be utilized. One of the greatest irrigation dams in the world is at Aswan. It was heightened in 1933 to double its capacity. Another is at Sint, on the lower Nile. During flood season the water runs into the irrigation canals by gravity; at other times it must be pumped. Canal irrigation prevents the layer of silt brought down by the flood waters from being deposited over the fields. Instead, it collects behind the dams, and its removal is a problem. The fields no longer bake and crack under this method, and this is thought to have had an important influence on the nature and condition of the soil.

Cotton, which comprises 80 per cent of the exports of the country, is the leading summer crop, others being sugar cane and rice. Autumn crops are those, such as millet and maize, with a short growing season. They can be planted after the flood season and can mature before the lower temperatures of the cooler season set in. The principal winter crops are wheat, barley, legumes, and clover, the latter for hay.

It is interesting to note the effect that the greater and more certain food supply resulting from perennial irrigation has on the numbers of people. The population has increased from about 10,000,000 in 1902, when the Aswan Dam was built, to more than 15,000,000 at present. This shows in striking manner the effect that increased means of subsistence have on the peoples of warm countries. The delta region is thought to have the densest population of any agricultural region of the world. Imports of food are necessary.

Foreign commerce. The foreign commerce of Egypt has recently been about $200,000,000 annually, exports slightly exceeding imports. As was stated previously, cotton provides most of the exports; cottonseed and other oilseeds are also important. The leading imports are cotton textiles, foodstuffs, chemicals, minerals, metal products, and machinery. Recently about 40 per cent of the exports have gone to the United Kingdom. Less important were the German Reich, France, Japan, the United States, and British India. The United Kingdom supplied 25 per cent of the imports, follow by the German Reich, Japan, the United States, France, Italy, and Rumania. The principal imports from the United Kingdom were cotton textiles, coal, iron, and steel, and woolen goods. Alexandria is the leading seaport.

The Suez Canal. The Suez Canal, now largely owned by private French capital and the British Government, is to revert to the Egyptian Government. It is a sea-level canal about 100 miles in length. The enterprise is profitable, annual dividends of 25 per cent ordinarily being paid. In volume of traffic the Suez-

ocean route ranks next after the North Atlantic route, the most important one. Even though the canal has been enlarged, not all vessels can navigate it. Half the vessels that use it are British.

PALESTINE AND SYRIA

The control of Palestine and Syria by Great Britain and France, respectively, prevents other powers establishing themselves in the region and provides a base from which industrial interests of Great Britain and France may exploit the natural resources of the hinterland, chief of which is the petroleum of Iraq. The two possessions are governed under mandates. Transjordan is administered under the Palestine mandate, but there is no provision for a national home for the Jewish people, as in Palestine. The people of these countries are largely Arabs of Moslem faith. Friction between them and other sects, and the nationalistic ambitions of the Arabs and their leaders create serious problems. A major problem is the conflict of Jews and Arabs for possession of the land. The outcome of this struggle bears directly upon industrial progress, because the Jews are the better farmers and will have the support of outside capital.

Natural resources and industries. Because of slight rainfall, pastoral occupations still predominate as they did in Biblical times. Because of the possibility of irrigation, there are greater agricultural prospects than have been realized.

Palestine consists of the plateau of Judea, bounded on the west by a coastal plain of 1,500 square miles, the most important agricultural section, and on the east by the lowland containing the Dead Sea and the Jordan River. This lowland, in turn, is flanked by a plateau which gradually merges into the desert. The plateau has fertile river valleys and enough rain to grow several crops—wheat, barley, and durra all being important. Along the coastal plain, various Mediterranean crops are grown, some of them under irrigation, and in the Jordan Valley banana growing is successful. The leading agricultural activity is the growing of oranges under irrigation near Jaffa.

Eastern Syria is shut off from rain-bearing winds by mountains and, consequently, is largely desert. But along the coast and in the westward-facing valleys are grown the same crops as in Palestine. The alluvial river plain around Damascus is a cereal center. The growing of cotton is increasing near Aleppo, and the French have provided capital for the purpose of increasing the production of raw silk.

Mineral wealth is not great in these countries. In the region of the Dead Sea are salt, sulphur, bromide, and carnallite (a source of potassium); and in other places are iron ore, potash, phosphate, and petroleum. Some of these deposits are being exploited under concessions.

Manufacturing, largely for local markets, is increasing in Palestine, where Haifa is the leading center. Some hydroelectric power is obtained from rivers, and there is also petroleum that may be used, and coal may easily be imported. The principal industries are oil refining, flour milling, and the manufacture of iron and steel, chemicals, soap, and cement. The manufacture of textiles is the only important industry in Syria.

Transportation. These countries are fairly well supplied with transportation, for they are crossed by important air lines and have several short railways and motor roads. The automobile and the paved road are particularly important in a region of this sort which cannot supply enough traffic to support private railways, and where much mileage would not be an advantage to a government. The coastal plain has always had important caravan routes which bring much trade to its ports.

Foreign commerce. In 1937 citrus fruits, almost all oranges, were 47 per cent of the total exports of Palestine. The trade in oranges has developed rapidly during the past decade, and now about 7 million boxes annually are shipped out. Soap and wine are other exports. The imports are distributed among many commodities, the leading ones being cotton textiles, motor cars, iron pipe, citrus cases, and flour. For some time imports have been from 3 to 5 times the exports. Many tourists visit the Holy

Land, spending money in the country, but the great excess of imports represents heavy borrowing to develop the country. Sixty per cent of the exports went to the United Kingdom, and twenty per cent of the imports were from that country. Other leading countries in the foreign trade were the German Reich, Syria, the United States, and Rumania. Haifa, with modern facilities, is the leading port; others are Jaffa and Acre.

In 1935 textiles were 25 per cent of the exports of Syria, and fruits and vegetables 20 per cent. Textiles likewise were a quarter of the imports, and metal manufactures and animal products each a third. One third of the exports went to Palestine and half as much to Iraq. France and the United Kingdom each supplied about a seventh of the imports, followed by Japan, the United States, and Turkey. Beirut is the leading seaport.

TURKEY

Natural resources and industries. Turkey, or Anatolia, is largely a high, dry plateau surrounded by mountains on three sides, with the other side sloping toward the Mediterranean, along whose shores there are areas of moist, fertile coastal plain. The plateau contains fertile valleys but is largely covered with poor grass, with scrubby timber in many places, and is fit for little but the grazing of sheep and goats. Winter rainfall, ranging from 20 to 30 inches along the coast and from 5 to 30 inches in the plateau, prevails.

More than 80 per cent of the people are engaged in agriculture and herding. The usual Mediterranean crops and the products of nomadic occupations are important. Wheat and barley are the principal crops, and olives are important in Aydin; others are cotton, tobacco, oilseeds, opium, and licorice. Turkey is the leading producer of the last, which is used in flavoring tobacco and confectionery. Bursa is the center of a raw-silk industry which has declined because of the cutting of the mulberry trees and the migration of the skilled workers during the War.

Turkey is the native home of the Angora goat and produces a better quality of mohair than any other country.

Turkey is thought to be rich in mineral resources, several of which are mined at present. Among these are chrome ore and emery, of which Turkey is the leading producer, and coal and ores of manganese, zinc, and lead.

Some manufacturing industries were once more important than now, but political and economic troubles caused a decline, and revival has been difficult because the factories were manned by Greeks and Armenians, who have returned to their own countries. Progress is being made, however, under plans which are described in the following section. The Vilayet of Aydin and Smyrna are the principal manufacturing centers, the former making carpets and textiles and the latter textiles, and sugar refineries, cement mills, and plants for crushing oilseeds are located at various places. Tophane has a Ford assembly plant.

Plans for economic progress. Since the World War Turkey has been trying to throw off the yoke of the past and take advantage of what Western civilization has to offer. Radical political and economic changes have been brought about under the leadership of a progressive president, the entire program having as its purpose self-sufficiency and a higher level of well-being. Large sums of capital, which Turkey lacks, are necessary for this, however, and it is difficult to borrow from foreign sources on a favorable basis. In 1929 an appropriation of $120,000,000 was made to build irrigation facilities, railways, port facilities, and breakwaters, and in 1935, $32,000,000 were appropriated for a five-year plan of industrialization, with the object of building fifteen factories and the development of hydroelectric resources and of coal, copper, and petroleum deposits. The textile, glass, paper, metallurgical, and chemical industries are receiving most attention. A large textile mill was opened at Kayseri in 1935.

Foreign commerce. The exports of Turkey are normally slightly greater than the imports, and the two combined have re-

cently averaged about $100,000,000 annually, which is roughly equal to the foreign commerce of Greece or Chile. Recently tobacco has comprised almost a third of the total exports, and wool and mohair, hazelnuts, and dried fruits each a little less than a tenth. Other exports are raw cotton, chrome, barley, coal, olive oil, eggs, and opium. Textiles and yarns are a quarter of the imports; cottons comprise about 75 per cent and woolens 25 per cent. Iron and steel and machinery comprise almost a fifth of the imports. Other imports are mineral fuels, paper products, chemicals, and tea, coffee, and cacao. The German Reich recently has bought about 20 per cent of the exports and supplied 25 per cent of the imports. Italy and the United Kingdom are each roughly half as important, followed by France and the United States.

Smyrna is the leading seaport. Istanbul is also important, being connected with Ankara (Angola) by a train ferry and the Anatolian Railway.

IRAQ

Iraq is independent, with large investments of British capital in transportation and industry. The important resources are the rich alluvial soil of the Tigris-Euphrates Valley, particularly in the upper part, and the reserves of petroleum around Mosul. Pipe lines have been built from the Mosul field to Haifa and to Tripoli, and large refineries have been constructed at Abadan for exploiting the oil resources. Petroleum is important to all of the Near East because of the dependence on motor transportation.

The leading crops are dates, barley, and wheat; others are tobacco, corn, sugar cane, and cotton. More irrigation facilities than now exist would increase the output of several of the subtropical crops. Crop production is concentrated in the upper part of the valley, the old Biblical country of Assyria. Dates and sugar cane, however, are grown in the lower valley, formerly Babylon, the dates being irrigated by flood waters carried by the tides, on the plain of Shatt-al-Arab. It has been estimated that

the two rivers have enough water to irrigate 7 million acres of land during the winter months, and 3 million during the summer months.[1]

In 1935 petroleum was a third of the exports of Iraq, dates 20 per cent, barley 6 per cent, and wool 5 per cent. Textiles were 20 per cent of the imports and machinery 5 per cent. Imports, because of borrowing of capital for development, exceed exports. Palestine, the United Kingdom, and Syria each took about 20 per cent of the exports; the United Kingdom supplied slightly in excess of 25 per cent of the imports, and Japan supplied 20 per cent. Basra is the leading seaport.

ARABIA

Arabia is largely desert except for several oases, the higher areas in the southwest and center that receive sufficient moisture to permit pastoral occupations, and a few coastal sections with enough rainfall to permit the growing of crops. The largest oasis is the Hasa Oasis, which is 20 miles long and 10 miles wide. The Nejd, a highland region in the center whose people have never been conquered in modern times, is famous for its animals because sufficient rain falls in the spring and autumn to permit a good growth of grass for a short period. Masqat is said to raise the finest Arabian horses and camels. Throughout the country camels' milk and dates are staple articles of diet. Dates are an important export through Basra. Yemen, famous for its coffee, also grows wheat and fruits. It is the home of Mocha coffee, the first commercial coffee, the tree growing on slopes where a mist rises and remains until almost noon every day. Some moisture is obtained from the mist, which also protects the trees from the hot rays of the sun.

Pearl diving is important along the shore of the Persian Gulf and on the Bahrein Islands, which are British. The diving season lasts for almost half the year, and it is said that about a half million

[1] I. Bowman, *The New World*, Yonkers-on-Hudson, World Book Company, 1922, p. 76.

people depend on this industry for their livelihood. Petroleum was discovered on the Bahrein Islands in 1932, and its exploitation is now a major activity.

Aden, a fortified British coaling station, is the leading commercial center of Arabia, being important as a distributing center for African trade. It is built in the center of an extinct volcanic peninsula.

In connection with Arabia the holy cities of the Mohammedans, Mecca and Medina, in the state of Hejaz, should be mentioned. Every good Mohammedan must make a pilgrimage to Mecca during his lifetime, and no matter how far away he lives, he usually saves the amount needed for the trip. Thousands of persons make this trip every year and bring thousands of dollars in business to steamship companies and to city merchants.

IRAN

Iran is all plateau, except for small areas of coast lands along the Persian Gulf and the Caspian Sea. In the former lowland, the oil industry is of the most importance; the latter lowland grows silk, cotton, sugar, and other crops. The plateau, a basin surrounded by mountains, is isolated. Along the inside base of the mountains the rivers disappear through porous limestone. Canals have tapped these underground waters and lead them to lower levels to irrigate crops of rice, tobacco, cotton, corn, and other products, and to furnish water for domestic purposes. The snow from the high mountains in the northwest also furnishes water for irrigating crops in the many fertile valleys of that region.

The Persians are noted for their stock breeding, which is one of their main occupations. Persian horses have the same qualities as those of Arabia. Sheep and goats, however, are the leading animals, and their wool and hair provide the raw material for the famed carpet and rug industry. Khurasan is famous for its wool.

The quality of these articles is determined both by the raw material used and by the number of knots per square foot, which may vary from 10,000 to 30,000. The rugs were made originally by women and children; but when the demand increased, men and boys also started making them, and factories became established. Each section of the country has its own designs, and the government watches the industry carefully, partly to prevent the use of aniline dyes. The best rugs are dyed with nonfading vegetable dyes.

Iran is rich in mineral resources, but petroleum is the only one of importance at present, and large reserves are believed to exist. The fields, on the slopes of the Zagros Mountains, are connected by pipe line to Mohammerah on the Persian Gulf. Some iron ore is mined in the mountains of the north, where a small iron-manufacturing industry exists to help supply domestic needs. Practically all of the world's supply of turquoise comes from a small area near Nishapur.

There are small-scale factories manufacturing various textiles, sugar, cement, tobacco, matches, and other products, several of the plants being state owned. Special attention is being given the textile industry, and cotton mills have been established in most of the larger towns.

In 1935 petroleum comprised 70 per cent of the exports, carpet and rugs 6 per cent, cotton 5 per cent, and fruits 4 per cent. Cotton textiles were 16 per cent of the imports, and iron and steel, machinery, and vehicles each were about 12 per cent. Exports usually are 2 or 3 times the imports. Trade is handicapped because much must move by caravan. The United Kingdom recently has taken 35 per cent of the exports, and the U.S.S.R. and Egypt each 12 per cent; the U.S.S.R. has supplied about 25 per cent of the imports, the United Kingdom 12 per cent, followed by the United States, British India, the German Reich, and Japan, each roughly of equal importance.

AFGHANISTAN

Although Afghanistan, containing roughly 251,000 square miles and 7 million people, is not a part of the Near East, it is discussed here because of its similarity in geographic features, economic activities, and international importance. Though the British have never been able to subdue the warlike Afghans, because of the mountainous country, they do control the Khyber Pass, which is sufficient for their purposes. This pass is 3,800 feet in elevation and is so situated that a few soldiers can hold back a large force. The British have never been eager to have the region to the north of this pass connected by rail with that on the south.

Afghanistan has many small plains and river valleys where cereals, vegetables, and fruits are grown under irrigation, preserved fruits being exported. The fat-tailed sheep, native to the country, furnishes meat for the native diet and a butter substitute from the fat of its tail. Wool and skins are the leading export. The finest quality of lapis lazuli, a gem of azure blue, is produced here.

SUMMARY

Of late the foreign commerce of these countries of Asia has been about $300,000,000 annually, imports slightly exceeding exports. This is a volume roughly equal to the foreign commerce of Denmark or Brazil. Exports consist largely of petroleum, the control of which has caused conflicts among world powers for territory in the Near East. With further exploration and more transportation facilities, these countries may provide added supplies of both minerals and animal and agricultural products; some of the last have only limited competition from other parts of the world.

37

UNION OF SOVIET SOCIALIST REPUBLICS

THE Union of Soviet Socialist Republics[1] contains about a dozen autonomous republics and about an equal number of autonomous territories, and six independent republics, which have adopted the Soviet form of government and are federated with the central government at Moscow. All but 10 or 12 per cent of the people are in former Russia, the majority being concentrated in the southwestern half. One gains some idea of the immensity of the U.S.S.R. from the fact that its area and population are about equal to the area and population of the continent of North America. It contains 14 per cent of the land area of the world and 9 per cent of the population.

Reasons for backwardness. The U.S.S.R. possesses such vast resources that some authorities believe that it will some day parallel the economic development of the United States, but several factors have hitherto retarded industrial progress.

Northerly position results in long, cold winters, and the large size, lack of water indentations, and large area of plain without protecting barriers cause an extreme form of the continental type of climate to develop and to be spread over almost all parts of the country. Drought, with ensuing hunger and starvation, is frequent and often widespread; nowhere is the rainfall heavy. These conditions tend to sap the energy of the people.

The large area of rectangular shape robs most parts of nearness to water transportation, and consequently long overland hauls to market are necessary. Furthermore, several regions are sepa-

[1] Henceforth the abbreviation U.S.S.R. will be used in place of this longer term, and wherever convenient the prerevolution names, Russia and Siberia, will be used.

rated, and some of the best ones are inaccessible. Were Siberia provided with cheap transportation, it might supply world markets with large quantities of wheat, beet sugar, and dairy products. The lack of cheap transportation and the lack of any transportation facilities over large areas have been the greatest handicaps to development. However, no part of the Ukraine, economically the heart of the country, is more than 30 miles from a railway.

The nation now has about 55,000 miles of railway, 70,000 miles of navigable waterway, and 60,000 miles of airway. The railway mileage is about a quarter of that of the United States, and 10 per cent consists of the Trans-Siberian Line, which was built largely for military and political purposes. Although through freight service has been established between the Orient and Europe, this railway is used mostly for passengers and mail. Ten days are required to make the trip from Vladivostok to Moscow, but three weeks are saved compared with travel by boat. This line has attracted many tourists to Siberia, and if it had more feeders on its south, it might haul considerable transit trade for China. Thus far it has been more important for local than for through traffic; the former is after all of major interest. Because of the danger of military attack, the U.S.S.R. started to reorganize its railway system in 1935. The plans call for 9,000 miles of new line, 6,000 miles of double track, and more than 4,000 miles of electrified line, a large part of the whole to be in Siberia.

Though the Volga and the rivers flowing to the Black Sea are important arteries of transportation, the majority of the rivers empty into the Arctic and are open only three or four months each year at their mouths. In their middle courses, however, they are ice free for about half the year and are important means of local transportation, acting as feeders to the railways. They would be much more useful, however, if their basins were connected by canals. Experts have recommended the construction of such canals, extending from the Urals to the Pacific, and claim that they could be easily and cheaply built. The Dnieper recently has been made navigable for 1,000 miles, with locks around

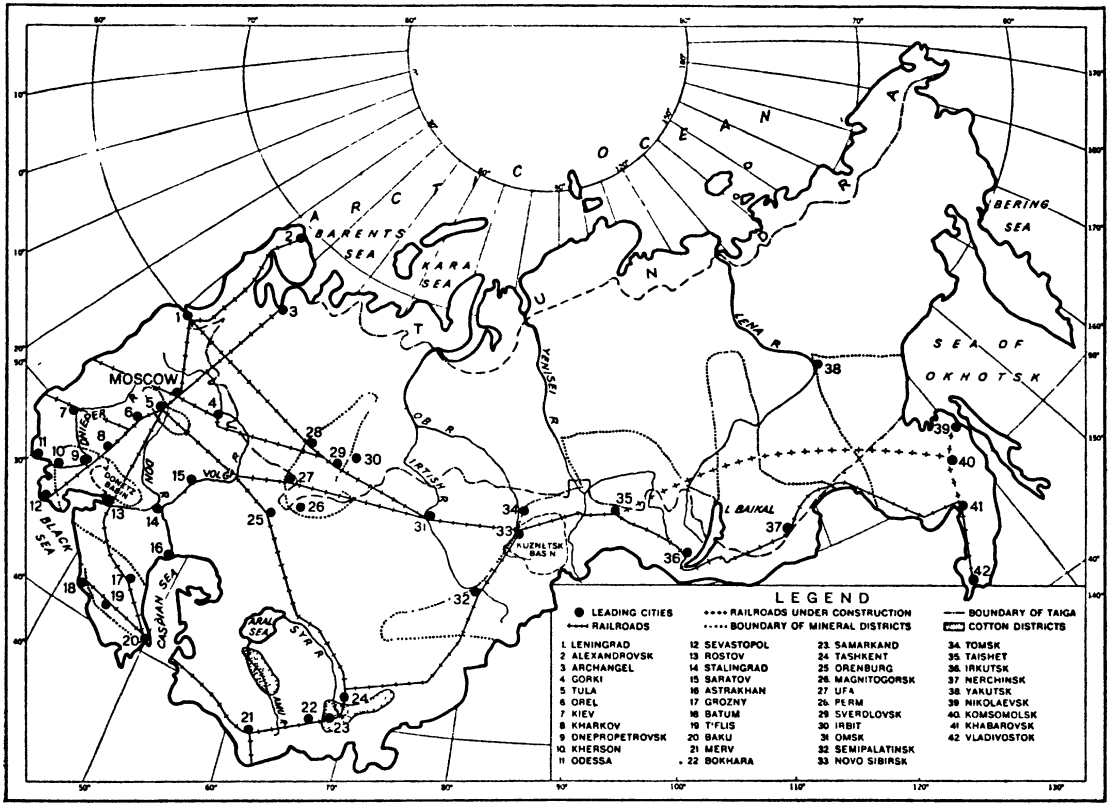


Fig. 202. The Union of Soviet Socialist Republics.

its rapids; and Leningrad and Archangel have been connected by an internal waterway, the intervening lakes having been joined by canals. Moscow has been connected with the upper Volga by a large canal, and projects to connect the upper Volga with the Baltic to make it possible for ocean-going vessels to reach Moscow and to connect the Volga with the Don to give the former an outlet on the Black Sea are under construction. The transportation handicap is gradually being solved, but much remains to be done.

The lack of a good seacoast has always been a sore spot with Russia and caused the Czarist governments to cast longing eyes in different directions, usually with undesirable political results. The Arctic coast has been almost useless, although recent exploration and investigation indicate that it may be more useful than has ever been thought. On the Murman coast the Atlantic Drift makes ice free the port of Alexandrovsk, which is connected with Leningrad by rail. The Pacific coast is far from the main centers of population, and the leading seaport there, Vladivostok, is closed by ice for three months. It has, in addition, a poor strategic location. The Baltic coast is also frozen for several months each year, and two other nations guard the entrance to Leningrad, the only port. The route past Istanbul also is controlled by other powers.

Until recently, government has retarded progress. The rule of the Czars oppressed the people and robbed them of incentive. The methods of the Soviet rulers have encouraged industry, and they have brought about an increase in the development of manufacturing. A related influence is illiteracy, in part a result of the extreme winters, which make it difficult to conduct schools. This problem the present regime is solving. A better educated body of people undoubtedly would have important industrial and economic influences. Another handicap has been the lack of capital, for the types of government have not been of a nature to attract great foreign investments.

Geographic features. Almost all of European Russia and two thirds of Siberia consist of a monotonously level plain of undis-

turbed horizontal formations. Some slight variety in topography is provided by occasional outcrops. The northwestern part has been glaciated recently and is similar in features to the glaciated parts of Poland and the Baltic States.

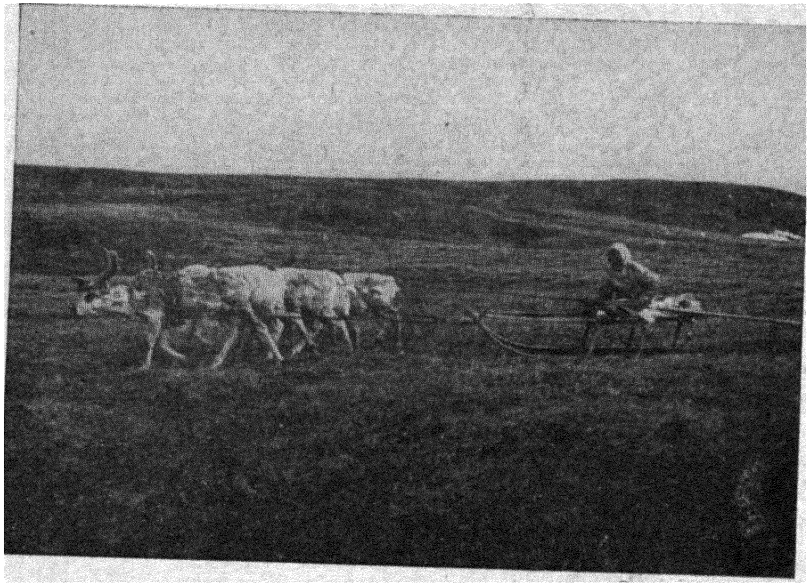
The consequences of this large level plain are an extremely large area under one government, there being no natural barriers to prevent expansion; uniform conditions of climate and therefore uniform types of agriculture over large areas; sluggish, navigable rivers, the Volga, which contains more than half of Russia in its basin, being an example; the ease of constructing canals and railways; and the mental effect on the people, already noted.

Climate. The U. S. S. R. has a continental type of climate, Siberia having greater extremes than European Russia, because, being on the eastern side of a land mass in the belt of prevailing westerlies, it is subjected more to land influences. In the majority of places, spring and autumn are of short duration, hardly existing at all. Temperatures are extreme because of the long period in which heat or cold may be accumulated by the land, resulting in wide seasonal differences in atmospheric pressure, which have a marked effect on the country and on all of the surrounding regions. Summer temperatures of 90° and in winter from 40° to 50° below freezing are common over large areas. The average summer temperature of Siberia ranges from 53° to 60°; that of winter from 10° to −53°. The winters there are dry and calm, with little snow and few clouds.

Precipitation is less than 20 inches annually in more than half of Russia and over most of Siberia. The height of the Caucasus Mountains causes them to receive heavy rainfall on the south, resulting in heavy forests and abundant water power. Other moderately watered sections are along the Pacific coast and around the Baltic, extending inland in places for seven or eight hundred miles. In Siberia, which is drier than Russia, the precipitation varies from 8 inches in the tundra, to 20 inches in the Amur region. The average for most of Siberia is 12 to 14 inches, about half of which falls in the summer. Southeastern Russia and the Turan lowland are

desert. Much of the moisture comes as snow, which covers the ground for four or five months and as it melts seeps into the ground. This, in connection with the cool climate and large areas of poorly drained soil, helps to counteract the light precipitation.

The tundra. The barren tundra, with short summers and light precipitation, extends completely across the country along the Arctic. Characterizing this region are the northward-flowing



Geographical Review.

Fig. 203. Summer sledging in the tundra near Golchikha.

rivers, with swamps and mosquitoes, lichens, shrubs, and mosses, often 5 feet thick, on which reindeer may graze. In Siberia the ground freezes to an average depth of 40 feet and never thaws deeper than 2 feet. It is said that the ground on which the town of Yakutsk stands has not thawed during the past 5,000 years. Near Spitzbergen borings showed the ground to be frozen to a depth of 650 feet. This freezing is important in view of the plans of the government to exploit the minerals and to industrialize the Arctic parts of the country. The ordinary methods of underground mining will not suffice. Much has been learned by a

commission appointed in 1931 to study and map the entire tundra. The airplane and the radio have been of great help in this work and in the development that has already taken place.

The people of the tundra are nomadic and make a living by herding reindeer, fishing, and trapping along the southern margin where the tundra joins the forest.

Forests. The U. S. S. R. has a forest area of two and one third billion acres, nearly half of it in Siberia. Acreages, however, are not always comparable. Though the eastern part of Siberia does have some large trees, on the whole the forests of Siberia are made up of smaller trees than those in Russia, with its less extreme climate and heavier rainfall. About 75 per cent of the forests are coniferous, consisting chiefly of pine, spruce, fir, cedar, and larch, the latter being a tree of large dimensions which predominates in eastern Siberia, and which, because of its durable wood, may be important at some future time.

The leading area is the coniferous belt, or *taiga,* which extends from the Baltic to the Pacific. Except near the Baltic, long distances overland to market and the lack of transportation facilities make competition with Finland and Sweden in the markets of western Europe difficult. The transportation charge is so much of the total value of lumber that any place that must ship far by rail is at a serious disadvantage. The system of labor under the present political order, whereby labor costs may be kept low, does give some competitive advantage to help offset the other unfavorable factors; and in spite of the numerous difficulties, there is considerable lumbering, even in Siberia. In view of the large markets for lumber in the industrial sections of western Europe, and of the large reserves of timber in the U. S. S. R., together with the need of the country for funds with which to continue its program for industrialization, the development of the forest resources is an important consideration. The smaller timber can be exported for paper and pulp and cellulose, for which there is also an important demand in western Europe.

The well-watered slopes of the Caucasus Mountains in Georgia have another large reserve of coniferous forests.

Moscow is the center of the deciduous forest region where much of the forest has been cleared to permit farming. There are also some hardwoods along the southern edge of the taiga in Siberia, and farther south in scattered stands over the plain.

Trapping. The sparsely settled taiga, with its many lakes and swamps, is an ideal home for fur-bearing animals and long has led the world in the production of wild furs. The quantity has been declining because of overhunting, however, even in such an inaccessible and unfrequented area as the forests of Siberia. Trapping is done by nomadic tribes when they migrate across the tundra toward the edge of the taiga, by peasants, and by those whose occupation it is.

The leading animal is the squirrel, which is found wherever spruce and cedar grow. The sable once was widespread but is now found only in the more inaccessible locations. Other animals are the fox, hare, ermine, marten, and bear.

The leading trapping districts are in northeastern Russia, where Irbit is the collecting market and in eastern Siberia, where Yakutsk is the leading collecting market in the nation. Furs are shipped from the latter by airplane. Most of the furs are exported through western Russia, going to Leipzig. Because of their relatively high value, furs can be shipped profitably for long distances and by rather expensive means of transportation.

Minerals. The U. S. S. R. has not been fully explored for its mineral resources, but the known supplies are immense, and almost all kinds are found. The important mineral areas are: the Donetz-Dnieper region, the Caucasus, the Tula Basin, the Urals, the territory between Semipalatinsk and Lake Baikal, the district to the east and northeast of Lake Baikal, especially at Nerchinsk, and eastern Siberia.

The Donetz-Dnieper region contains 90 per cent of the coal reserves of European Russia and is the largest reserve of Europe. Seventy-five per cent of the iron ore, some of sixty per cent purity,

occurs at Kherson. The Caucasus region leads the world in the production of manganese and is second in petroleum. The Urals are a wealthy mineral region, having large reserves of several kinds. Deposits of many minerals occur throughout Siberia, but at present the mining of gold is most important, Tomsk, Irkutsk, and Yakutsk being important centers. The Altai Mountains are known as the Gold Mountains. Along the base of the Sayan Mountains from the Irtysk Valley to Lake Baikal are several important deposits of coal, the leading ones being in the Kuznetsk and the Irkutsk basins, where the reserves are five or six times as great as those of European Russia. The Kuznetsk basin also contains the important Telbes deposits of iron ore. Copper ores are widespread in Siberia, and production is now at three times the rate prevailing during the period 1926-30.

The mineral deposits of the U. S. S. R. are widely scattered and are located to a large extent around the edges of the country and at long distances from centers of population. Furthermore, many deposits are located unfavorably with respect to fuel, and thus expensive hauls for smelting are required.

Water power. According to conservative estimates the U. S. S. R. has eight and one half million horsepower of potential water power, of which 5 per cent has been developed. Most of it is distributed, much as the minerals, around the edges of the country. Half of the total is in the Caucasus and 30 per cent in the lake region of the northwest. The Urals have about 15 per cent and central Russia and eastern Siberia small amounts. Several hydroelectric plants have been built, one of the largest being at Dnepropetrovsk.

Agriculture. Only 9 per cent of the U. S. S. R. consists of arable land, of which 75 per cent is under cultivation. In 1934 the collective farms controlled 85 per cent of the cultivated land, some of these, especially the ones near Rostov, being very large and highly mechanized.

Methods of cultivation have been poor in the past, and although there has been improvement, there is still room for much progress;

the more uncertain climate, however, prevents the high average yields that are obtained in western Europe. In spite of the small proportion of arable land and the low yields, the U. S. S. R. stands next to the United States as an agricultural nation, and in several of the staples ranks ahead of this country in acreage though not usually in the quantity of production. One must not forget the large size of the two countries, however, in making comparisons

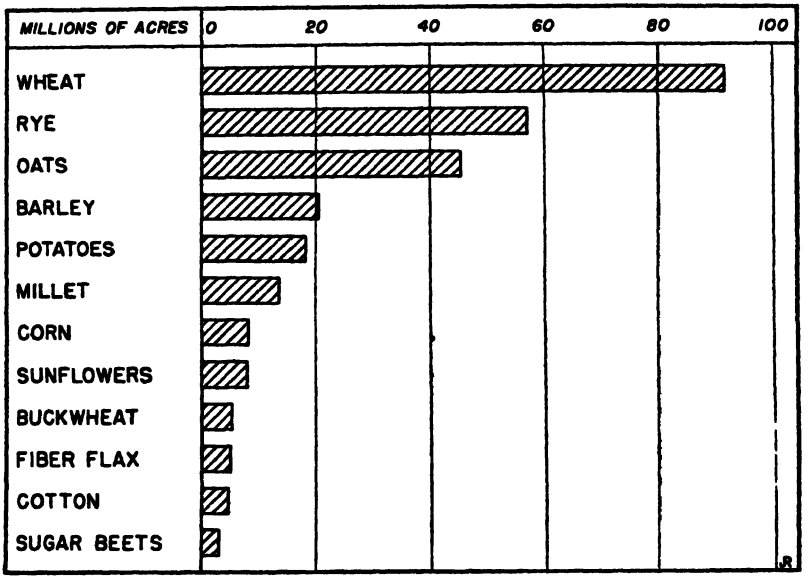


Fig. 204. Acreages in principal crops of the U. S. S. R. in 1935.

with other countries. The Ukraine is the leading agricultural section; 65 per cent of its land is arable.

For several years after the Revolution there was a decline in the production of the crops normally exported and greater production of those that were consumed domestically. This seems to have been the policy adopted by the government at the time, but the production of all crops was disorganized by the measures of control adopted. Since industrialization of the nation has become the policy, relatively more attention is being paid to the growing of export and of industrial crops, the former to obtain funds with which to carry out industrialization, and the latter, among which

are flax, hemp, sunflower, sugar beets, and cotton, to provide raw material for the factories.

Crops. Cereals, for whose production Russia has been noted, occupy about half of the cultivated land (Fig. 204). Climate, soil, and transportation combine to locate the different crop centers. Wheat is the most important, and 70 per cent of the crop is of the spring variety, the winters being too severe except in the protected valleys of the Caucasus for winter wheat. The areas where it is profitable also have spring and early summer rainfall. The leading wheat soil is the *chernozem,* or black earth, a loess soil of great water-holding capacity and occurring largely between Kiev and Tarnbov but also extending into Siberia. Since wheat has been an export crop and there are insufficient railways, it has been grown as near the export points as possible. The same may be said of barley, which is grown in those parts of the spring-wheat belt that are near the Black Sea. Yields are low and fluctuating, all of the cereal districts of Russia being subject to severe drought and those of Siberia to the danger of unseasonable frost because of nearness to the Arctic and the large areas of swamps and lakes.

Rye and oats are grown for domestic consumption and therefore do not have to be grown so near the seaports. Rye by necessity is the bread crop of the majority of the Russians; the oats are needed for horse feed in a country where corn is only a minor crop. The heaviest production of each is in a broad belt to the north of the wheat region; there the soil is poorer and the climate cooler and more moist than in the leading wheat area. If the government attains its goal of a higher standard of living for the masses of people, wheat should gain relatively to rye as a breadstuff. Corn is grown in the more moist, milder southwest near the seaports because a large proportion of the crop is exported, and at the east end of the Black Sea. The production of wheat has recently been about double that of the United States; that of corn is normally about 135 million bushels.

The U. S. S. R. leads the world in the growing of fiber flax, hemp, and sunflowers; the latter two are grown for the oil that is

obtained from the seed, and considerable flax is grown for the same purpose. The main flax district is in the cool, moist northwest with its poorly drained soil, in a narrow zone extending westward from Moscow almost to the Gulf of Riga. Hemp is grown largely to the southwest of Moscow, and sunflowers, a dryland crop, are grown in the southeast along the dry margin of the wheat belt.

The Russians have been making a determined effort to expand their production of cotton, and with considerable success. Practically the entire acreage is grown under irrigation, chiefly in the upper valley of the Syr near Tashkent. Other districts are near Bokhara and in Azerbaijan. From 85 to 90 per cent of the domestic demand for cotton is now met, and some is exported to western Europe. It is of good quality, and in the case of exports the labor advantage that was mentioned in connection with the exporting of lumber should be remembered. Millions of acres in the Turan lowland would grow cotton were there water to irrigate them. More railways would also help. It is possible that this region may some day provide an important market for foodstuffs grown in the Siberian plain. This would help to expand cotton production because food crops then would not have to be grown locally so much.

Root crops are widely scattered. Potatoes are concentrated largely in the deciduous forest belt. Sugar beets occupy a large acreage in both European Russia and Siberia, where the possibility of growing the crop offered an inducement to colonists. A supply for local consumption is provided, and it is a product that can stand the expensive transportation to other parts of the country. The crop also provides the basis for an animal industry. Domestic supplies of sugar are important in case of war.

Tobacco, a poor quality of dark heavy tobacco for snuff and for plug, is grown in a small area to the east of each of the sugar-beet districts. Turkish tobacco is grown along the northeast shore of the Black Sea and to the east of the Sea of Azov.

Middle-latitude fruits are grown toward the Rumanian border

and citrus and other subtropical fruits in Crimea, the Caucasus, and the Turan lowland. The Batum district has tea plantations which were planted by Chinese workers. The Russians are great tea drinkers and obtain large amounts from China by caravan. The tea district is an excellent one for citrus fruits, and a recent plan is to set these crops and grow the tea farther inland.

Animal industries. Eleven per cent of the area of the U. S. S. R. is in pasture, and consequently the grazing of cattle and sheep is important. The great extent of the agricultural lands requires large numbers of draft animals, although there has been an increase in the use of tractors with the rise of the large collective farms. There is also the economic basis for an important swine industry. Horses and cattle are more numerous in the more moist, more densely populated parts of southern and western Russia. Beef cattle are most important, but there is considerable dairying in the Baltic region, in the northeast near the Urals, and in the Siberian plain—in the first region for the same reasons that have made dairying important in all of the Baltic countries, in the other two because of the long distance to market, since these products are valuable enough to withstand the expensive transportation. Swine are grown throughout western Russia, where they are fattened on potatoes, corn and other cereals, and skim milk. Because of dairying and a local market it is thought that swine production may become important in the Siberian plain, where the cold weather also produces a good quality of bristles for commercial uses. The number of swine in the U. S. S. R. has almost doubled in the last decade and is now about half of the normal number in the United States.

Sheep are grazed largely in the drier southeast. In this region and in the Turan lowland and the southern part of the Siberian plain there is considerable nomadic herding, but the expansion of crop production in this plain is gradually crowding the nomads southward.

Manufactures. The territory of the U. S. S. R. has been largely agricultural in the past; the cold climate, lack of capital, possibili-

ties in agriculture, lack of technical skill and education, and low purchasing power among the masses all have retarded the development of manufacturing. During the past decade, however, the determined efforts of the Soviet regime in carrying out the provisions of its two five-year plans have industrialized the nation to the extent that in 1934 manufactured products represented 78 per cent of the combined value of agricultural and manufactured products. The original five-year plan emphasized the production of heavy goods, the second, consumer goods.

The leading industries are the manufacture of iron and steel, machinery, textiles and leather goods, and the processing of agri-

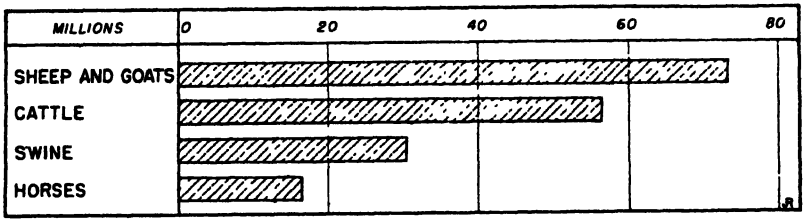


Fig. 205. Numbers of different kinds of animals in the U. S. S. R. in 1936

cultural products. Industrial production has increased sixfold during the past ten years. Since 1928 the manufacture of cement has increased four times in amount, and since 1932 the production of glass and knitted goods has increased three times, that of iron and steel and of phosphates has more than doubled, and that of sugar and of canned goods is 50 per cent greater. The manufacture of leather and of paper and pulp has also grown.

The leading manufacturing centers are: the Moscow-Tula-Gorki district, the Donetz basin, the Perm-Sverdlovsk district, and the Kuznetsk basin in Siberia, the latter being new.

The first-named district is the oldest and most important. Moscow obtains coal near by and also from the Donetz field, and oil from the Caspian district. It has leather, china, engineering, and textile industries, with the number of cotton spindles equal to the combined number of North Carolina and South Carolina

Coal and iron ore both occur at Tula, which has an iron and steel industry and manufactures hardware and textiles. Gorki manufactures automobiles and is a trade center; until 1930 it was the seat of one of the world's great annual fairs. Leningrad manufactures textiles, the flax district has a hand lace and embroidery industry, and western Russia has woodworking industries.

The coal and water power, iron ore, and manganese and location near water transportation will probably cause the Donetz basin to become a great metallurgical center. This type of product is already important in the district between Kharkov and the Sea of Azov.

Railway equipment, ordnance, and agricultural machinery are the leading products of the Perm-Sverdlovsk district, the region having coal and several other minerals, and Sverdlovsk has an important gem-polishing industry.

The Russians are trying to develop the Kuznetsk area as one of the leading manufacturing centers of the nation, particularly for iron and steel. In addition to having abundant supplies of coal and iron ore and other minerals, Kuznetsk is isolated and is, therefore, protected against outside attack. At the same time, however, it is distant from the main markets for its products. The manufacture of iron and steel and the smelting of gold are now the important industries.

Foreign commerce. It will be noted (Fig. 206a) that the imports of the U. S. S. R. are largely those products which are necessary to carry out the plan of industrialization. With the realization of this policy these products should decrease in importance because they will be supplied more and more by domestic factories. For several years exports have been greater than the imports. Although the country normally has had a net export, the Revolution and consequent events and industrialization caused imports to be larger for many of the years preceding 1933. Recently the United Kingdom and the German Reich have purchased about 20 per cent of the exports each and have supplied 18 and 10 per

cent respectively of the imports, followed by China with 12 per cent of each, and then by France, the United States, Iran, and the Netherlands, each roughly of equal importance.

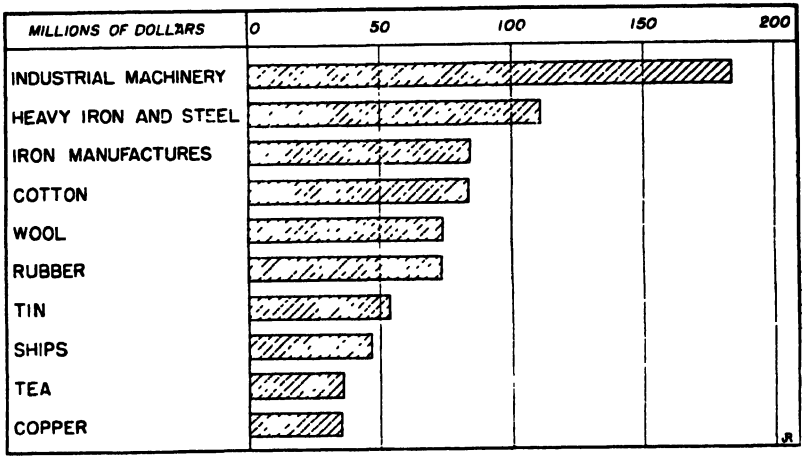


Fig. 206a. Principal imports of the U. S. S. R. in 1935.

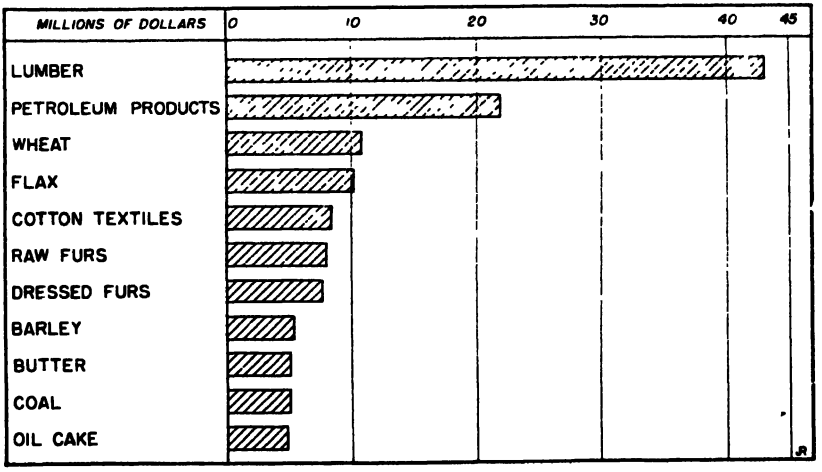


Fig. 206b. Principal exports of the U. S. S. R. in 1935.

Foreign commerce, like nearly everything else in the U. S. S. R., is under the direct control of the government, and for this reason there may be sudden shifts in its direction, depending upon the bargaining power of the officials with the industrial interests of

other countries and upon the government attitude toward the official policies of other countries.

Trade is carried on through the Black Sea ports, those of the Baltic States, and Leningrad. Before the War, Riga was the leading port of Russia and was ten times as important as Leningrad. Trade has now shifted to some extent to the latter. It has an artificial harbor with a 22-foot channel which is kept open some of the time with icebreakers. On the Black Sea, Odessa, Kherson, and Rostov are all important ports. Astrakan is the principal port on the Volga. There are several Arctic ports, among which are Archangel and Aleksandrovsk, which would have significance in the event that other outlets to the sea are cut off in time of war.

Conclusions. Although the cold climate of the U. S. S. R. has an adverse mental effect on the people and makes manufacturing costs relatively high, and although many supplies of natural resources are poorly located with respect to centers of population, there is, in the immense forest and mineral resources, the vast expanse of agricultural land, and the large and growing population, the basis for an important manufacturing country, and one which can be largely self-sufficient. To be sure, capital and cheap transportation are scarce, purchasing power is low, and the people lack education, skill, and experience necessary for the most successful manufacturing, but in time these handicaps may be largely overcome. Industrialization may gradually create the added income and wealth necessary to supply income and capital, and to educate the masses. Furthermore, the country has broken with the past. Under the Czar the peasants were exploited unmercifully by the nobility, but the present leaders have created a greater incentive for work.

38

THE JAPANESE EMPIRE AND MANCHUKUO

Divisions and population. The Japanese Empire (Fig. 207) is composed of the string of islands extending from central Sakhalin to Taiwan, and Chosen. Several groups of former German islands are administered under a mandate. Including Manchukuo, this is an area a quarter as large as the United States, and with an equal population. Japan proper has 69 million people, Chosen 23 million, and Manchukuo 34 million, the density ranging from 68 per square mile in the latter to 469 in Japan proper, which contains only 20 per cent of the area under Japanese control but 55 per cent of the people. Honshu, the main island of Japan, is the same size as Chosen, with twice as many people. In 1936 Japan had the highest birth rate of any country.

Although Manchukuo is technically not an integral part of the Japanese Empire, yet, because of friendliness and understanding between officials of the two countries, and because of Japanese ownership of industrial and trading companies in Manchukuo, the political and the economic activities of the two countries are so interrelated that it is logical to include them together.

Factors in progress. Japan has been called the Great Britain of the Orient. While there are important similarities which have been major influences in the shift from a feudal to a modern industrial civilization in the remarkably short time of three quarters of a century, yet Japan falls short of the industrial and commercial advantages possessed by Great Britain. Similarities are insularity, rugged coast line with good harbors, near-by fishing grounds, supplies of coal and a few other minerals, nearness by water to large populations, location at one end of a great ocean route, and in-

dustrious people. These are important advantages, to be sure; but Japan lacks the early start and capital accumulation, invigorating climate, abundant supplies and favorable combination of coal and iron ore, central location at meeting of many ocean routes, and adaptable and inventive people like those of Great Britain.

Although the Japanese are thrifty, energetic, ambitious, and

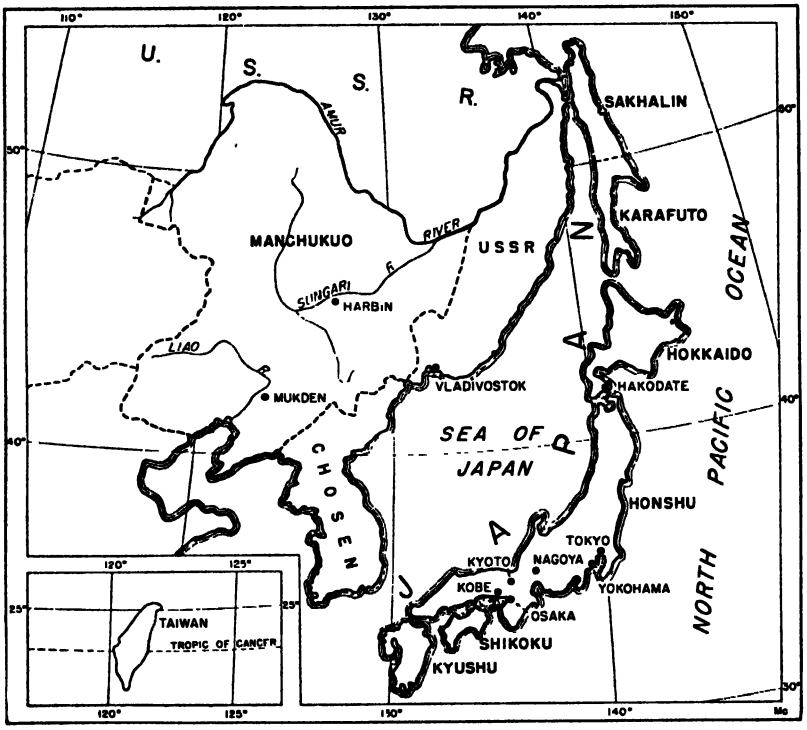


Fig. 207. The Japanese Empire and Manchukuo.

intelligent, they are not so active or so strong as the people of the United States or Europe because their climate is more enervating and because they are not fed so well. Their artistic temperament and their ability to imitate what others have done have been important influences in their rapid industrial progress; but more important, some authorities think, has been the superior intelligence of the ruling class. The original migration from the mainland, insularity, and the fishing industry all are thought to have exer-

cised a selective effect, which helps to account for the mental qualities of the Japanese.

Geographic features. Structurally, Japan is a string of volcanic islands along a line of weakness in the earth's crust; as a result it is subject to much destructive earthquake and volcanic activity. The country is so mountainous that only 20 per cent can be cultivated, and the only important lowlands are at Tokyo and Osaka. Speaking generally, the islands are composed of two parallel ranges of mountains separated by a rift valley in Honshu. In the south, one range forms the long southwestern extension of Honshu; the other forms the islands of Shikoku and Kyushu. In the north, the two ranges separate in Hokkaido, the one forming the Kurile Islands and extending into Kamchatka, the other extending through the island of Sakhalin.

The ruggedness and narrowness of the islands cause the rivers to be short and swift, making them suitable for the development of water power, which is potentially of four and a half million horsepower, but not suitable for navigation. They carry much silt and choke the harbors at their mouths.

Climate. Narrowness and the highly indented coast subject Japan to the influence of the ocean, but length, ruggedness, and location with respect to the land mass of Asia and to ocean currents combine to cause considerable climatic diversity. The January isotherm of 32° crosses Honshu just north of Tokyo. North of that isotherm the winters are somewhat similar to those of New England. The southern parts of Kyushu and Shikoku have winters like those of our Gulf coast, and the intervening region has winter temperatures similar to those prevailing between New York and Florida. The mountains make the east coast warmer than the west. The July isotherm of 68° passes between Honshu and Hokkaido. The northern parts of the islands have summer temperatures like those of Canada, the southern part like those of parts of the United States.

On the whole the climate is of the temperate monsoon type. The seasonal extremes of pressure in the interior of Asia cause the

winds to blow from the southeast in summer and from the northwest in winter. The cold land winds of winter, somewhat tempered as they cross the Japanese Sea, are further warmed by the branch of the warm equatorial current that flows along the west

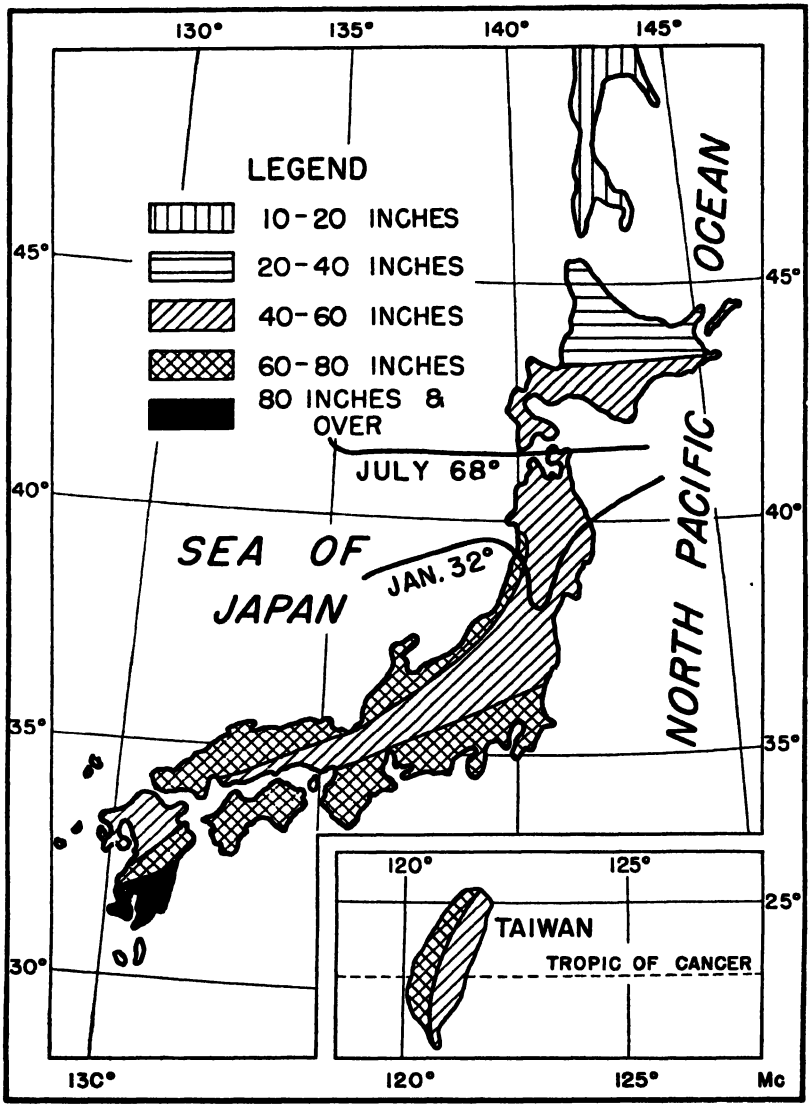


Fig. 208. Annual rainfall of Japan and Taiwan and the January isotherm of 32° and the July isotherm of 68° in Japan.

coast. The major part of this current flows northward on the east side of the islands, but there is a cold current between it and the land. These currents have no effect in winter because of the wind direction, and but little in summer because there is not much difference between their temperature and that of the ocean. They do create fogs.

Rainfall occurs chiefly in the summer and is heavy over most of the islands but is considerably more to the south than to the north of Tokyo, and heavier on the east side of the islands than on the west. The western coast of Honshu has heavier precipitation in winter, chiefly in the form of snow, however, because the winds warm as they cross the sea and on striking the mountains precipitate their moisture.

Forests. In spite of the large proportion of the land that is forested, Japan lacks large amounts of merchantable timber and consequently must import much lumber from the United States. Intensive use is made of the forests, however, and scientific methods are employed in their cultivation and exploitation. The manufacture of pulp and paper, matches, and other products that do not require large cuts are important industries. The forests are largely coniferous except in the south, where subtropical and deciduous trees prevail, the former being in the warmer lowlands, the latter on the cooler slopes. The cooler north also has deciduous trees. Karafuto has large areas covered with larch and fir. About 60 per cent of the forests are privately owned.

The common variety of bamboo, a native of the monsoon region of southeastern Asia, is one of the most serviceable of plants, being put to a multitude of uses by the people of these countries. The stems are used for the framework of houses and as masts for ships, are split and woven into lattice work for walls and when bored out serve as water pipes for reservoirs and gardens. The larger joints are cut apart and used for pails and other large containers, and the smaller ones for cups, and a fluid that hardens into a valuable medicine collects in them. The leaves are used to make the

roofs of houses, and various parts of the plant for fashioning a large number of household necessities. Paper may be made from the inner wall of the stem, and knives from the hard outer covering. As a food, the seed may be substituted for rice, and the young shoots used like asparagus. The ordinary fishing pole of the United States is made from Kentucky cane, a relative of bamboo.

Minerals. Although her minerals have been a major factor in industrial progress, Japan is not well supplied with them, and it is likely that the importance of recent acquisitions in Asia has been exaggerated. Coal has been of most importance, and has recently comprised 80 per cent of the total annual value of minerals, followed by copper and gold, each of equal value. Japan is on the north Pacific Ocean route, and the coal supplies, by drawing ships there, give commercial advantages that otherwise would not be enjoyed. The leading center of coal mining and exporting is in the region of Nagasaki. A second center is at Hakodate, and there is coal in northern Honshu and in Karafuto. The district to the north of Tokyo is the leading producer of copper ore in the Orient. This mineral is particularly important because it has facilitated the development of hydroelectric energy, 40 per cent of the potential amount having been developed.

Petroleum occurs in northern Honshu and in Karafuto, but production is slight and falls far short of national needs; and there are ores of gold, silver, and lead in various places. Kaolin is plentiful, and the porcelain ware of Japan is famous. There are sulphur deposits, mainly in Hokkaido, which, with the forests, provide the basis for the manufacture of matches.

Fisheries. Fishery products have an important place in the Japanese diet and are used extensively for fertilizer. The fishing industry, indeed, has had a great influence in making Japan a naval and maritime power. Rich fishing grounds near Japan and along the coast of the mainland and in the Russian waters to the north are of great importance to the country. The abundance of fish is due largely to the ocean currents, and the indented coast is a great

aid in conducting the industry. The leading species are herring, mackerel, sardines, and tunny.

The Japanese also utilize other products of the sea. Seaweed, grown commercially in protected waters along the coast, is used in a variety of ways for food. The production of pearl oysters is also important. A pearl is caused by a grain of sand or similar object getting inside the shell of the oyster. The Japanese, by a delicate surgical operation, place a piece of mother of pearl underneath the shell of the oysters, put them in wire cages, and place the cages in protected areas of water along the coast. About seven years are required for the pearl to develop. In the meantime care and watchfulness are necessary.

Agriculture. Dense population, a low standard of living, and the small proportion of arable land make the agriculture of Japan highly intensive. The garden or spade method prevails, more than a third of the farms containing less than 1½ acres; 4 acres is a large farm. Almost 90 per cent of the farmers carry on some other occupation. Tenants farm 40 per cent of the land, peasant proprietors the remainder. The soil of the alluvial plains, containing volcanic material, was naturally of moderately good quality, though not especially fertile. It had to be built to its present high state of productivity. But in spite of the intensive methods, food in increasing amounts must be imported.

Crops. Rice occupies two thirds of all crop land and contributes two thirds of the total value of all agricultural products. Barley, wheat, and mulberry trees each occupy about 10 per cent of the crop land. Rice acreage is well distributed but is heaviest in the hot, wet southeast. In the north other cereals occupy almost as much acreage as rice; in the south they are grown as winter or dry-season crops on the rice land. In some places barley and wheat are grown on the hill lands and rice on the flat lowlands and terraced slopes. Multiple crops and intertillage are important features of Japanese agriculture.

The production of vegetables is widespread, being greatest in the southeast where population density is greatest. Other crops

are millet, potatoes, sweet potatoes, tobacco, sugar beets, cotton, indigo, soybeans and other legumes, and tea. Potatoes are grown in the cool north, millet in the drier northeast part of Honshu, and the others in the warmer south. Tobacco, a government monopoly, and sweet potatoes are grown largely on the ashy plateau soils of Kyushu. Tea, which has declined owing to competition from British India, is grown on terraced slopes in the southeast. Green tea, as contrasted with the black tea of India, is produced, and it has a market in the United States, where the green variety is preferred.

The Japanese diet consists largely of rice, fish, eggs, vegetables, and tea. In the poorer districts barley or millet replaces rice, or is often boiled with it. Sweet potatoes and soybeans are supplementary food products in the cities.

Silk. Because Japan is the leading producer of raw silk and the United States its leading consumer, the methods of production are of general interest to us. The requirements for successful silk culture are a moist subtropical climate to grow several crops of leaves on the white mulberry tree and a dependable supply of cheap, experienced labor. A great proportion of the labor is required to rear the silkworms and to unwind the cocoons, and considerable experience is necessary to acquire the proper skill. Any of the work is light enough to be done by women and children.

There are two divisions of the industry, the production of cocoons, which involves the growing of mulberry trees, and reeling. A million acres are in mulberry trees, which, in addition to providing food for silkworms, provide a crop for the rugged lands and thereby help control erosion. The best quality of silk also is from leaves that grow in the uplands. The government maintains general supervision over the industry, but the filatures, the establishments where the cocoons are unwound, control it directly, distributing the eggs, supervising the production of cocoons, and purchasing the cocoons from the farmers.

The steps in the production of cocoons are (1) the production of eggs, (2) hatching, and (3) caring for the worms until the

cocoons are spun. The female moth lays eggs on sheets of paper which are kept in cold storage for as long as one year. Hatching is done in incubators. At the age of one month the worms start to spin their cocoon, but during this month each one has eaten 50 times its weight in leaves. Every pound of raw silk requires 300 pounds of leaves. The average mature tree produces about 210 pounds of leaves annually. The leaves must be selected with care and be dried, since moisture injures the worms, and fresh ones must be supplied regularly. An even temperature and good ventilation must be maintained, and the trays which hold the worms must be changed and cleaned often. Before they start to spin their cocoons, the worms are transferred to wooden frames containing twigs, to which they attach themselves. About a day is required to spin the cocoon. An ordinary cocoon contains about 300 yards, and 1,000 miles of the fiber or 10 pounds of cocoons are required to make a pound of silk. The worms are next killed, usually by heating the cocoons in an oven at a temperature of 200 degrees. Otherwise in about 3 weeks the worm would turn into a moth and cut its way out of the cocoon, spoiling it for good grades of silk. The cocoons are then dried; afterwards they may be stored indefinitely before being reeled.

Reeling, though a simple process, requires skill and care, and many years of experience are necessary for proficiency. Several threads (as many as 20 for coarse counts) are gathered together and wound into a yarn. The one in charge must watch for broken threads and variations in the thickness of the threads, and maintain a supply of cocoons. If a thread breaks, it must be tied; if the threads change in thickness, some must be added or taken away to maintain uniformity. This must all be done without stopping the reel. One person is able to care for 2 reels.

Japan produces about two thirds of the world's silk. Cocoons from China are also imported and reeled. From 80 to 85 per cent of the crop is exported, largely to the United States, where Japan has practically a monopoly of the market. Its high and uniform

quality and the method in which it is wound adapt it particularly to the machine methods of manufacture in this country. European manufacturers prefer Chinese silk, which has a better color than Japanese, but which is of a poorer quality.

Two million farmers are engaged in growing silkworms, this being their only important money crop, and the industry supplies almost 20 per cent of the total agricultural income. Production



International Silk Guild, Inc.

Fig. 209. Mulberry trees.

is concentrated in the central provinces, chiefly in the uplands of central Honshu, the Suiva district being most important. In the opinion of some, the accelerated industrialization of Japan will result in the migration of the industry back to China, whence it originally came, and where, with less rapid industrialization, wages will remain lower.

Manufactures. Japan has risen rapidly in manufacturing and has been penetrating world markets with some products, to the

disadvantage of several other countries. The main competitive advantage, low wages, is a result of the dense population and low standard of living of the people; another is nearness to the millions of the Orient, who, although per capita purchasing power is low, demand large quantities of cheap goods, the type that on the whole the Japanese are best fitted to make. Some advantage is also obtained from the newness of the factories, the most modern methods prevailing, and for a while from a depreciated currency. Opinion is divided over probable long-run success. Some see a great future industrial country; others, mindful of the qualities of

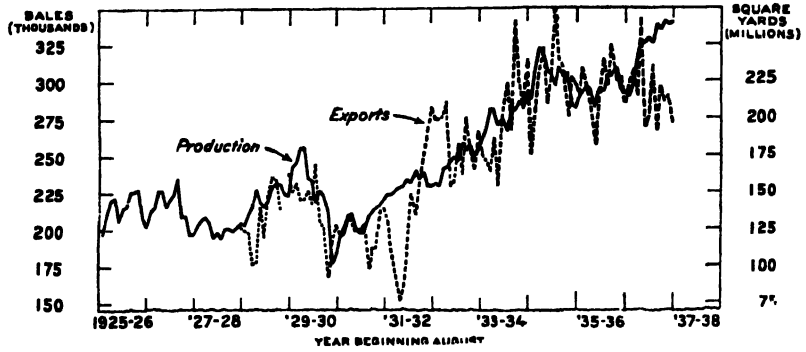


Fig. 210. Production of cotton yarn and exports of cotton cloth in Japan

the Japanese and the fact that they have been an agricultural people for centuries, do not hold so much hope. Minerals of course are not plentiful, and it is said that physical and technical deficiencies prevent the people from becoming good steel workers. The existing steel industry is subsidized by the government.

The manufacture of textiles usually accounts for about 35 per cent of the total value of manufactured products, cotton products being half of the value of all textiles, followed by rayon and silk, each of equal value, and wool. Next are metal products and chemicals, each contributing 16 per cent, and then machinery and food products, each roughly with 12 per cent. Osaka is the leading textile-manufacturing center and also builds ships. Tokyo and Yokohama and Kyoto, the old capital city, have a variety of

industries, the latter being the center of silk manufacture and important for artistic wares. Nagayo is noted for its pottery. Nagasaki has a shipbuilding industry.

Foreign commerce. The foreign commerce of Japan is shown in Figure 211. The imports of iron and steel consist largely of scrap. Japan, whose iron and steel industry depends much on this product, leads the world in importation. The exports and imports

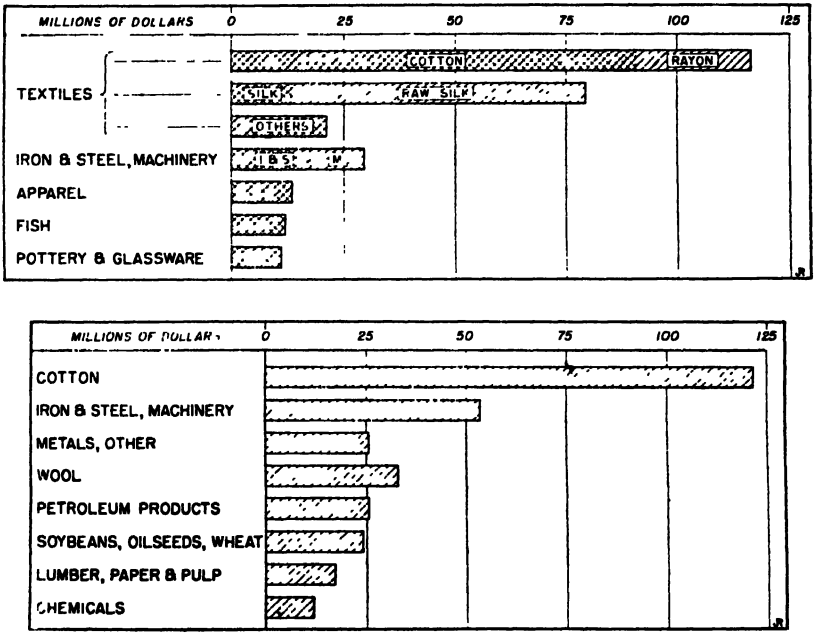


Fig. 211. Principal items in the foreign commerce of Japan in 1935: exports above, imports below.

were fairly evenly balanced until 1920, when the imports became slightly greater. The United States recently has taken 20 per cent of the exports and has supplied about 33 per cent of the imports. Both British India and China are 60 per cent as important as the United States and are followed by Australia and the United Kingdom.

Yokohama, the port for Tokyo, is the leading seaport, and Kobe, the port for Osaka, is second. Osaka is also a seaport but has de-

clined in importance because of the silting of its harbor. With Kobe it forms a great manufacturing district. Nagasaki is a coal-exporting point and a naval base.

CHOSEN

Chosen, independent from 1894 to 1910, was in the latter year annexed to Japan to prevent its acquisition by the Russians. Its people, 60 per cent of them illiterate, now enjoy political equality with the Japanese, but they nevertheless resent Japanese rule because of its strict and, to them, oppressive methods. The Japanese own a half of the cultivated land.

The country is a mountainous peninsula, rich in undeveloped resources. The chief handicap to development is the lack of transportation, this being particularly important in connection with the mineral wealth. Some progress has been made, however, in recent years in providing more facilities for development. The peninsula presents a steep face to the east and a longer slope to the west. The agriculture and the people are thus concentrated on the lower lands in the west.

Chosen is largely agricultural and provides foodstuffs and raw materials for manufacture in Japan, and a market for Japanese manufactures. Practically all of its foreign trade is with Japan. It also provides some outlet for the overcrowded populations of Japan. Rice, grown on one third of the cultivated land, is the leading crop and leading export. Other important crops are barley, soybeans, cotton, silk, and some millet and hemp. Cattle and swine are also raised, hides being one of the more important exports. The cattle, of good quality, are exported.

Gold, mined in the north, is the leading mineral, but there are also reserves of coal and ores of iron and copper.

TAIWAN

Taiwan, similar to Chosen in structure, is the only important tropical part of the Japanese Empire. Because of the tropical products, the Japanese are paying much attention to its develop-

ment. Agriculture and the mining of coal are both increasing. The best part of the island is the lower, more level west, where there are people of Chinese descent; the east is inhabited by backward people of the Malay stock.

The leading products are rice, sugar cane, corn, jute, tea, and camphor, Taiwan leading the world in the production of the latter. Camphor, which is used for medicinal purposes, is obtained by distillation from the wood of the laurel or camphor tree, which grows in various parts of the Orient. The output of cane sugar has increased so much that now Japan is independent of the rest of the world for this product. In the highlands of the north some of the highest quality of tea is grown, the famous Oolong tea being from terraced slopes along the Tamsui River. In addition to coal there are deposits of gold, silver, and copper ores.

MANCHUKUO

Control. Manchukuo is important to the Japanese for strategic reasons and because of its undeveloped agricultural, mineral, and forest wealth. It is a natural meeting place of Chinese, Russian, and Japanese expansion and influence. Japan, because of disorganized political conditions within both China and Russia and because of the long distance of the most important part of the Russian territory from the area, has been able to dominate. The country further furnishes a base from which the Japanese may work for continued expansion on the continent.

The resources of Manchukuo will make it an important influence in the greater industrialization and self-sufficiency of Japan. Some authorities claim that the climate of Manchukuo is too cold for the Japanese, but it may, nevertheless, relieve the overcrowded conditions in Japan by furnishing food and raw materials for manufacturing, which may tend to shift the people more from agriculture into manufacturing, with a tendency toward results similar to those in Great Britain.

Nearly all of the inhabitants of Manchukuo are Chinese who have migrated there in large numbers since 1923 and who have

been attracted by the undeveloped agricultural resources and the more stable political conditions than prevail in the well-settled parts of China.

Geographic features. Manchukuo has a central plain, consisting of the basins of the Liao Ho and the Sungari River, and mountainous areas on both the east and the west, those on the east being the higher, although neither group is extremely high. The plain has fertile soil, owing in part to volcanic material washed down by the rivers.

Climate. The climate of Manchukuo is similar to that of the spring-wheat region of the United States. Much of the land is covered with snow for 4 months, and the rivers are all ice-bound in winter except in the extreme south, and even there ice fringes the coast. On the Amur River navigation stops in October and does not open again until May. The winters have much clear weather and many cold, dust-laden northwest winds.

Rainfall averages about 25 inches annually, with a summer maximum, which is an advantage because of high temperatures and inability to grow winter crops.

Forests. The forests of Manchukuo, located largely in the eastern highlands, cover an area of 90 million acres, almost double the acreage of forests in Japan. The leading species are oak, walnut, pine, and fir, 60 per cent being broad-leaf trees. The best stands of trees are in the southeast, where the rainfall is heaviest. Oak and spruce predominate in the northern part of the eastern highlands, while there are forests of larch and birch in the northwestern part of the country. These forests are being used and destroyed rapidly. They are near good markets, Japan and China both finding it necessary to import lumber. There is considerable trapping in the mountains of the eastern part of the country.

Minerals. The leading minerals are coal, iron ore, and magnesite, but there are several others. At present the mining of coal is most important. Several fields are situated on the slopes of the highland around the edge of the plain, where, in time, manufacturing may develop. The most important coal-mining center is

at Fushun, where the world's largest open-pit coal mine is located. The coal is used domestically and is exported to neighboring countries. The reserves are not large.

Manchukuo contains the bulk of the iron-ore reserves formerly possessed by China. The ore, however, is low grade and offers difficulty in manufacturing. The reserves are nearly all in the south, extending from the border of Chosen to Yiukin. The leading center for mining iron ore and for manufacturing iron is Anshan.

Agriculture. The country's greatest possibilities are in agriculture. From 20 to 25 per cent of the land is arable, and about 60 per cent of this is already cultivated. The soybean is grown on 25 per cent of the cultivated land, Manchukuo ranking second in its production; it is the leading cash crop and the most important export. It furnishes food for man and feed for animals, materials for industrial uses, and fertilizer. The Japanese use it for fertilizing mulberry trees. Kaoliang and millet occupy 20 and 16 per cent respectively of the cultivated land. Both are used for man and beast, the former being the staple food of the people. Millet has a stalk from 8 to 14 feet tall which is used for fences and fuel, while the leaves are made into mats upon which the people sleep. Wheat, grown largely in the north, occupies 11 per cent of the cultivated land, and corn, in the rough southeast, about 9 per cent. There are possibilities for greater wheat production. The production of sugar beets and flax is progressing slowly at Harbin and Mukden, where suitable soils are found, and cotton and fruits are grown in the lower Liao Valley and on the Liaoling Peninsula. Ginseng, used in manufacturing drugs and medicines, is also grown.

CONCLUSIONS

The most urgent problem of Japan is overpopulation, or a low standard of living, and conquest cannot solve it immediately or directly, if at all. The Japanese do not thrive in the cold winter climate of Manchukuo; there is no room for them in China even if

conquest there is successful; and other possible places of settlement are largely closed to them. However, by obtaining control of territory with greater potential markets for the products that she is fitted to manufacture, she may in time raise her standard of living. Recent economic and political policies have aroused resentment where it can be afforded least; new territory is often not so rich in resources as it is thought to be; and Japan lacks abundant capital with which to exploit the territory over which she has gained control. These drawbacks almost certainly will make progress slow. Furthermore, while the industrial progress of Japan has been remarkable, the country still does not rank alongside the great industrial nations. Her foreign trade is one third as great in value as that of the United States, and the value of manufactured output is less than 10 per cent as much. Certainly there is a long, rough road to travel before she can become an industrial country of the first rank.

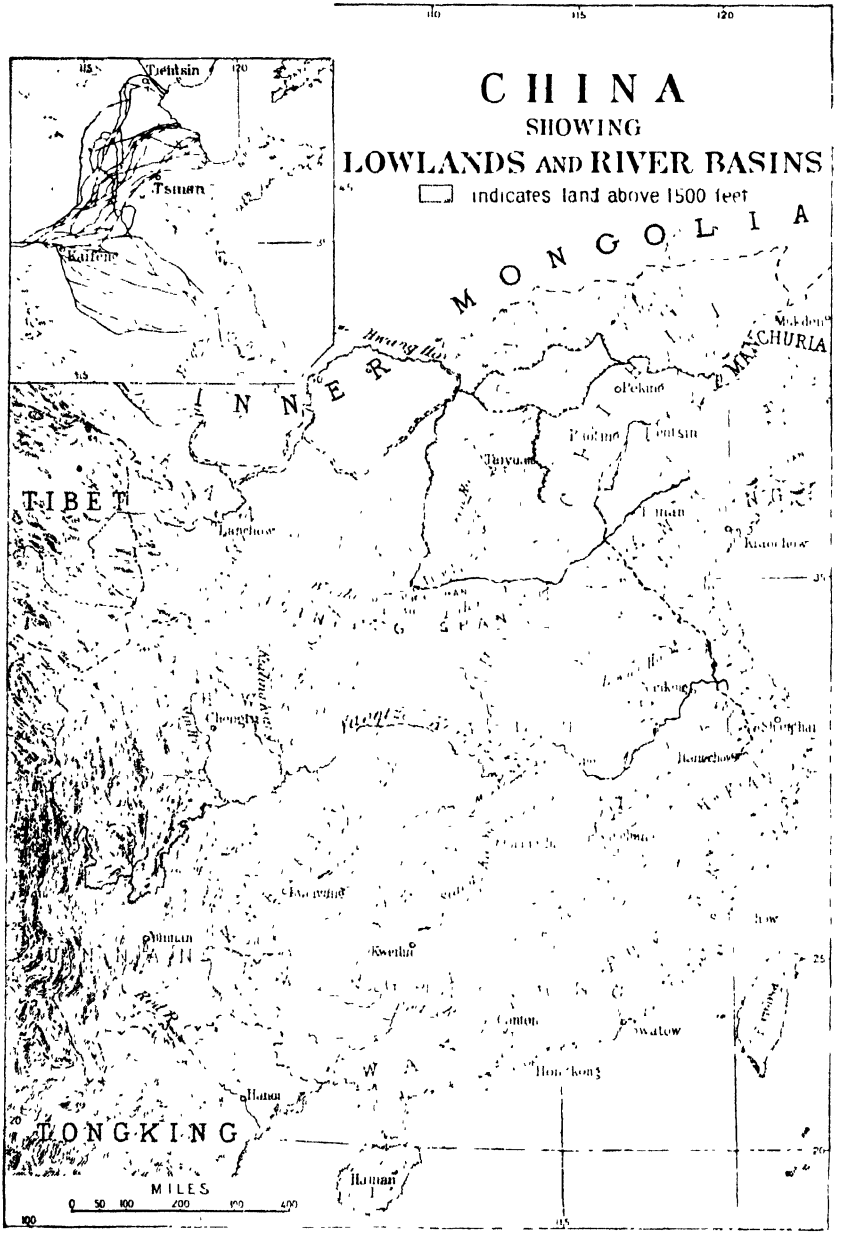
39

THE CHINESE EMPIRE

Area and population. The Chinese Empire, composed of China proper, Mongolia, Tibet, and Sinkiang (Fig. 212), has about the same area as Europe and 85 per cent as many people. China proper contains 40 per cent of the total area and 98½ per cent of the population; and in this 40 per cent, the people are concentrated in a relatively small area, density ranging from 60 per square mile in Kansu to 900 in Kiangsu. The northern plain has 647 per square mile; the Yangtze basin, 847.

Lack of progress. Several influences are responsible for the unprogressiveness of China. Isolation from the rest of the world due to mountains, high plateaus, deserts, the sea, and long distances has prevented beneficial contacts. Ancestor worship, which tends to hold people near their old homes and which perpetuates the clumsy methods of the past, is carried to an extreme. Unity has been made difficult by a lack of national spirit. Until recently, the people of the north, who are conservative and monarchically inclined, controlled the government. A republic was established in 1911, but internal friction has continued. Control is now with the more progressive and democratic people of the south.

Another serious handicap is the lack of overland transportation facilities. This lack, by limiting exchange of products between the various sections of the country, is a factor in the severity of many of the famines. China has about 100,000 miles of navigable waterways, of which much use is made, but the different sections cannot all be connected in this manner. Mountains, wide rivers, the many canals, and the swampy nature of the rice lands all make



H. H. Mallory, "China, Land of Famine"

Fig. 212. Chinese Empire.

the provision of overland transportation both difficult and costly, and capital is scarce.

There has also been foreign control of such matters as concessions, commercial privileges, and tariff policies. Conditions that were favorable chiefly to other nations have been forced upon the Chinese.

Geographic features. China proper is largely mountainous, with several fertile river valleys and basins. Old rocks emerge in all parts, but on the whole the north consists of younger formations than the south. The country may be divided on the basis of the three important river valleys, the Hwang Ho or Yellow River, the Yangtze Kiang, and the Si Kiang or West River.

The Yellow Valley consists of the delta plain which is a former arm of the sea and the loess highlands to the west between the Great Wall and the Tsinling Mountains. The latter region consists of a yellowish silt which the winter winds have blown to an average depth of 300 feet. Much of it has been redeposited on the plain by the rivers. Loess soil is fertile, but since it is porous it dries out rapidly and is easily eroded by almost any agent. Kalgan, in the center of the loess region, commands a mountain pass, through which a caravan route connects Peiping with western Asia. Peiping also commands the natural route through the plain of Manchukuo.

The Yellow River is of slight use for navigation, and its floods do much damage and cause many famines. There is a serious flood about once every 40 years and less destructive ones much oftener. Floods become increasingly serious because the river flows on top of the plain between natural levees and artificial dikes and is gradually building its bed higher and higher. This, in conjunction with the filling of the depressions of the plain with silt, causes each succeeding flood to spread farther than the others. This river also has changed its course several times. The delta coast of northern China lacks good harbors and important seaports.

The Yangtze basin is composed of the lower plain or the area

below Hankow, the lake section between Hankow and Ichang, and the Red Basin or Szechwan. The plain of the lower section is similar to the plain on the north of the river except for a milder climate. The lakes along the middle section help temper floods and provide extra water at the low stage of the stream. The Red Basin, as large as France and with twice as many people, was once a great lake. Surrounded by mountains, it has a milder winter climate than prevails along the lower Yangtze, and communication with other countries is more difficult.



W. H. Mallory, "China, Land of Famine."

Fig. 213. In the loess country in Western Honan.

Between Shanghai and Ichang the Yangtze is one of the best and one of the most important of navigable rivers. Ocean boats can go to Hankow and smaller steamers to Ichang, above which rapids in the narrow gorges impede transportation but do not prevent it altogether. Below Hankow the depth varies from 30 to 60 feet and the river is 30 feet higher at flood than at low-water stage.

The region of the West River system consists largely of mountains, the only important plain being the delta on which Canton is located. This region is an old crust block which extends to the sea, making a rugged coast with many good harbors, which have made fishing an important activity and have trained people to the

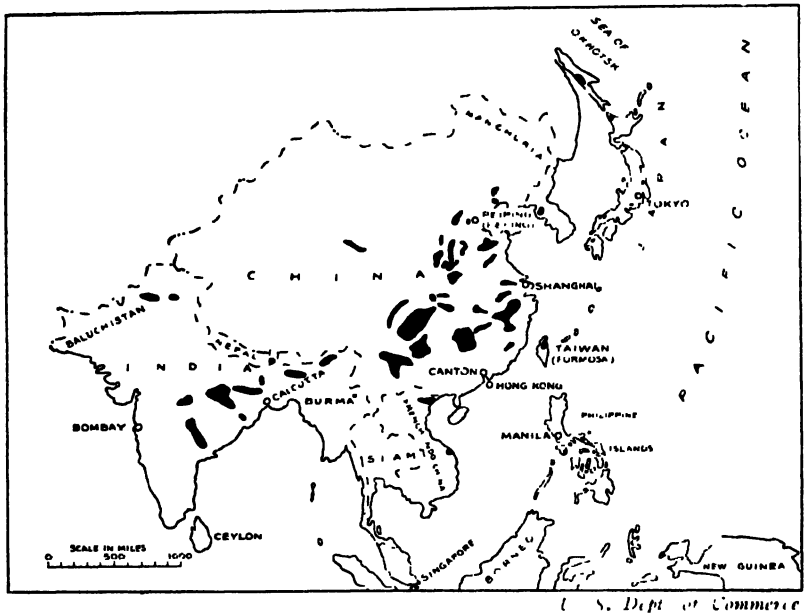
sea. Most Chinese emigrants are from along the coast of this section. Along the rivers and coast of this region, and in other parts of China as well, many people live permanently in boat houses which are fastened to the shore. At Canton 150,000 live in this manner. Typhoons often drown many; one of these storms in 1922 brought a wall of water 20 feet in height. The rivers of this part of China are short and rapid. Wuchow is the head of navigation on the West River. There are important reserves of metals and considerable timber in the western part of the West River basin.

Climate. The climate of China proper is basically of the monsoon type, but large area, north-south extent, and variations in topography cause considerable variety. Climatically, and physically also, the country is divided into two parts by the Hwai Ho and the Tsinling Mountains. Summer temperatures are nearly uniform throughout the country, but the winters are much more severe in the north; winter temperatures in southern China are similar to the summer temperatures of northwestern Europe. The east coast of China, and also Chosen, because of cold northwest winter winds and because of cloudy summers which prevent the sufficient accumulation of heat to counteract the effects of winter, are, for their latitude, the coldest parts of the Northern Hemisphere. The winter winds of northern China are strong, dry, and dusty and often make a fog over the Yellow Sea so dense that navigation is impeded. It is impossible to build houses that will keep out the dust.

To the north of the Hwai Ho-Tsinling boundary is a land of hardy cereals, cattle, and horses; to its south, a land of rice, tea, bamboo, and water buffalo, where from two to four crops may be grown each year. Although two crops may be grown in favored locations, the north grows chiefly summer crops.

Minerals. China proper has rich deposits of several minerals, and it is likely that the outer provinces, which are largely unexplored, may be found to contain important deposits of many different ones. The most important is coal, in which China ranks

second to the United States in total reserves. Most of the provinces contain coal, but the chief field is in the highlands of Shansi and Shensu along the great bend of the Yellow River. Shansi has over 80 per cent of the anthracite, 55 per cent of the bituminous, and 30 per cent of the lignite of the nation. Bituminous coal comprises 80 per cent of all of the reserves. There are other important coal deposits in the Red Basin, and to its south and east.



U. S. Dept. of Commerce

Fig. 214. Coal fields of Southeastern Asia

China has lost an important part of her iron-ore reserves to Manchukuo, but there are deposits in the anthracite coal area of Shansi, which has the oldest iron industry in the world, and in Chihli, Shantung, and other places. The Tayeh deposits near Hankow, consisting of high quality ore, are the leading ones at present. While the iron-ore reserves of China are small compared with those of many other countries, they are large enough to furnish the supply needed by the country for a long time to come.

Yunnan and other provinces of the south and southwest comprise another important mineralized area. Yunnan is said to have

one of the richest copper-ore deposits in the world. Its leading mineral, however, and the leading mineral export of China, is tin. The Yunnan region is under the economic control of the French, who, through French Indo-China, control the only railroad into the area.

Hunan supplies two thirds of the world's antimony and considerable tungsten. The area around Swatow on the coast is the leading center for mining wolfram, from which tungsten is obtained. The province of Kiangsi also produces tungsten. These same provinces also have important deposits of mercury and molybdenum. A negligible quantity of petroleum is produced in Shensi and along the upper Yangtze, and oil shales occur in Shansi; but as far as we have any reliable information, China is poor in petroleum and natural gas. There are scattered deposits of kaolin which are thought to be inexhaustible.

Agriculture. Only 13 per cent of the land of China is arable, and because of the large population and abundant cheap labor, the arable land is cultivated very intensively. About 80 per cent of the people are farmers. Heavy summer rainfall, fertile alluvial soils, a long growing season, the productivity of the crops which are grown, and the methods employed all combine to make Chinese agriculture highly productive in food per unit of land used. Yields for most crops are above the world average. Other influences which help to make it possible for the land to support such a dense population are the lack of animals, the low standard of living, and the relatively mild climate of most parts of the country. For these reasons fewer animal products are used, and it is possible to subsist on less food than in a colder region. Ninety per cent of the Chinese diet consists of vegetable products.

China is a land of garden farmers, the average farm being about 2 acres, and vegetable production has attained a high state of perfection. The land has been farmed for centuries, and because of the application of fertilizer and because of crop rotation its fertility has gradually been increased. One must remember, however, that rice production itself aids in solving some of the problems of

maintaining soil fertility. All sorts of refuse are saved for fertilizer, and even the mud from the canals is spread over the land. The methods of crop rotation are among the best in the world. Wherever the climate permits, from 2 to 4 crops per year are grown, and legumes have an important place in the combinations.

China probably grows almost every known crop. In acreage, wheat, rice, kaoliang, millet, barley, and corn rank in the order given. The acreage in wheat is only slightly greater than that in rice. Rice, wheat, and millet are the great food crops and together occupy about 75 per cent of the cultivated land. Reliable or complete statistics are not kept in China, but it is thought that China might rank first among the countries of the world in all of these crops except corn, and in the production of sweet potatoes, peanuts, tea, and silk as well. Generally speaking, hardy cereals, legumes, and middle-latitude fruits are leading products in the north, and rice, legumes, corn, cotton, sugar cane, wheat, oilseeds, silk, and tea in the Yangtze basin and southward. Rice is grown on the lowlands, and tea, the mulberry, and oilseeds on the slopes.

To show how a densely populated country makes itself almost self-sufficient in food, the combinations of crops and the methods of production and rotation will be given with some detail.

Crops. Of the cereals, rice is most important and most characteristic of China. It is important throughout the Yangtze basin and along the southeastern coast near Canton. The Canton Delta is one of the most intensely farmed sections of China and, with the basin of the West River, is the leading rice-growing region. Two crops of rice and a crop of vegetables are produced each year. The vegetables grow during the cool season. Quick-growing, hardy varieties of rice will grow as far north as the latitude of Vladivostok. In northern China, rice growing is limited by uncertain rainfall and the large amount of sandy soil. Wheat and millet have about the same distribution and are limited largely to the inner plain and valley of the Yellow River, although wheat extends southward and millet northward from this region.

Wheat occupies the more fertile soils of the regions where both are important. In the southern part of the wheat district winter wheat is grown on the land after the rice is harvested; in the northern part spring-sown crops prevail. Barley is grown widely, being substituted for wheat in locations where the latter does not do well, particularly at high altitudes. Buckwheat is grown widely also, but it is most important in the colder mountainous districts of the north and west. It is often planted on land on which the millet crop has failed.

Oilseed crops, including soybeans, peanuts, sesamum, rape, and wood oil, are important in China. The soybean, of which there are several varieties, is foremost in importance, and the acreage is gradually increasing. It is grown in northern China on former millet lands and as a summer crop following winter wheat. The beans are used as food for man and beast and for industrial purposes in the manufacture of soap and of drying, lighting, and lubricating oils. For human use they are made into bean curd, flour, and oil. The residue remaining from the preparation for other purposes may be fed to animals or be used for fertilizer. Peanuts also are grown in the north on dry, sandy soils that are fit for nothing else. Sesamum, a southern crop with a short growing season, is grown widely, also on poor, sandy soils, and makes the best cooking oil of any of the oilseed crops. Although its oil is not so palatable as that of most of the other plants, rape is one of the most generally cultivated oilseed plants, being grown mainly in the central and southern parts. Wood oil, an industrial oil (see p. 207), is obtained largely from the nuts of the tung tree, which is grown chiefly in Szechwan and Hunan along the tributaries of the Yangtze.

There are several other important food crops. Sugar cane is grown in the warmer south and west, as a perennial as far north as 28° and as an annual to 30°. Only about 10 per cent of the sugar requirement is produced domestically. Swatow and Hong Kong have modern sugar refineries, but most of the crop is refined by crude processes. The sweet potato is another crop of the

warmer south, and its growth is expanding. It is unpopular with some of the classes, however, for it is considered as food fit only for coolies.

Fruits have a small but relatively important place in the food supply, especially in the north where grains are grown. Though middle-latitude varieties predominate, the south has largely citrus fruits. In the north, where Shantung is the center of production, the pear leads by far, followed by the apple, peach, and apricot. The peach, persimmon, and jujube are grown widely, the latter preferring to grow against stone walls. About 80 different varieties of the orange and the pumelo, grape, pomegranate, and litchi are fruits of the south.

Tea. Tea, grown first in China, is used extensively to add flavor to drinking water, which must be boiled to protect health. The trees are largely in gardens of small holders, the work of growing and the preliminary preparation for market being done by members of the family. It is then sold to a merchant who in turn sends it to a central market, where the curing processes are completed. China, like Japan, produces green tea. In the case of some of the better qualities each leaf is prepared and packed individually. The leading tea region is the hills on the south side of the Yangtze Valley; other regions are in the Red Basin and on the hills overlooking the Strait of Formosa. Hankow is the great center of the tea trade. The industry has been declining because of competition from British India, where the industry is better organized and is conducted more scientifically.

The opium poppy is a profitable crop wherever it can be grown, so profitable, indeed, that it often crowds out food crops. It is often grown with the connivance or support of governing authorities. Though planted in several places, it is most important in Yunnan and Kweichow. In northern China it is a winter crop, being harvested in June and July, after which the land is used for a catch crop. In the south it is planted in autumn in the rice fields and harvested in the spring. It grows best on light soils but needs heavy fertilization and careful cultivation. The raw

opium is harvested either before sunrise or after sunset. A slit is made in the side of the maturing seed pod, and the latex is squeezed out. This process is repeated at intervals. After congealing, the latex goes through various processes to prepare it for market. It is easy to smuggle because of the high value in small bulk.

Tobacco is grown widely and acreage has been increasing until output is almost as great as in the United States. The prohibition of the opium poppy has probably increased tobacco production. In the south tobacco is a winter crop; in the north, usually a summer crop, sometimes grown simultaneously with other crops.

China's important vegetable-fiber crops are cotton, hemp, and ramie. Cotton is grown principally in the lower Yangtze Valley and the western part of the northern plain, largely on land from which the winter wheat and root crops have been harvested. Hemp is grown mainly in the north, where the climate is too cold for cotton. Ramie, which is adapted to warm conditions, grows in the central and southern sections.

Although it is commonly believed that cotton is grown in large quantities, the fact is that the commercial supply is small, and furthermore the fiber is so short that its use is limited under machine methods. However, small amounts are exported to Japan. Hemp was once the most important vegetable fiber of China, but ramie is displacing it as a source of textile fiber. The latter produces a cool cloth and makes an excellent quality of paper. A problem in its use, as in the use of other excellent unused vegetable fibers, is the inordinate amount of labor required to prepare it for manufacture. Even though labor is cheap in China, it can more profitably be put to use in the production of the more easily obtained supplies of textile fibers.

Silk. China produces about a quarter of the world's commercial raw silk, and some people think that were accurate statistics available, the total production might be shown to be two or three times that of Japan. Japan does not seem to possess any inherent advantages over China, and, were more scientific methods

of production employed in the latter, the industry might be much more profitable. For some time various forms of encouragement have been given to the development of improved methods. The Yangtze Valley is the center of the industry. Kiangsu, where mulberry trees line the banks of the canals, is the leading province, producing, with Chekiang and Anhwei, 40 per cent of the total crop. Silk culture is the leading industry in Szechwan, half of the land in some places being in mulberry trees. The crop is important also in Yunnan and Kwantung. In the former it has been encouraged to give the peasants a crop to replace the opium poppy, which was once important. Much of the silk is exported, because few Chinese are wealthy enough to afford silk costumes. It goes principally to Europe, as it is not prepared in a manner adapted to the machine methods of the United States.

Animals. Although domestic animals are relatively unimportant throughout the Orient, China does have moderately large numbers of most kinds. With the exception of swine and poultry, they are largely in the colder northern and dry outer provinces where population is less dense than in the rice districts. In these regions they are used more for draft purposes than for food. Where population is dense, people cannot afford to keep animals, such as cattle and horses, which consume crops that may be used for human food; on the other hand, poultry and swine, being scavengers, can live on feeds that man does not use for food. Only the Moslems eat much beef, and the use of milk is almost unknown. Fat pork has an important place in the diet of most Chinese. Swine, often fattened by being turned into the peanut and sweet potato fields to eat what was missed in harvesting, are an important item of trade between various sections. Bristles from the swine are an important export. More cattle than any other kind of animal are used for draft purposes. They are most important in the cooler north; in the rice fields they are replaced by the stronger water buffalo. Chickens, ducks, and geese are abundant and widespread, chickens in the north

and the others more in the warmer south, where the amount of water is greater. Eggs are important in the diet of the Chinese. Poultry production is not conducted scientifically or on a commercial basis. China, however, is the world's leading exporter of eggs. The cormorant is bred for fishing, and in some sections most of the fish are caught by these birds. A ring is placed around the bird's neck to prevent its swallowing the fish.

Manufactures. Although large-scale factory production has grown gradually in China for the past quarter century and in several industries modern methods are superseding native methods, manufacturing is done mainly in the homes and small workshops, where large numbers of workers make goods that are in common use throughout the country. Almost every home has equipment for making textiles, and some products—for example, porcelain and rugs—are made in this manner for export. Factory production is being increasingly dominated by Japanese capital, with some British capital also invested. More foreign capital might be attracted if political conditions become stable. Japanese capital migrates to China to take advantage of lower labor costs than prevail in Japan, and it is probable that there are lower taxes and advantages in marketing, since China is an important market for Japanese goods.

Advantages for manufacturing possessed by China are large supplies of coal, some iron ore and a number of other raw materials, and a large population to provide a cheap supply of labor and markets.

The leading industry by far is the manufacture of cotton textiles, in Shanghai, where half of the spindles are located, and in Canton, Tsingtao, Tientsin, and other places; woolen and silk factories are located in these same cities. China has about $5\frac{1}{2}$ million cotton spindles, or about the same number as North Carolina. The Japanese own about 40 per cent of the cotton textile industry.

The manufacture of iron and steel ranks second and is dom-

inated to an even greater extent by the Japanese than is the cotton-manufacturing industry. The principal center for iron and steel is Hanyang, near Hankow.

Other industries are the milling of flour and rice, the manufacture of cigarettes, glassware, matches, carpets, and cement, and the tanning of leather. The output of cement has grown of late because of the demand for highway construction.

Most factory production is concentrated in the seaports and larger cities along the lower courses of the rivers. This is necessary because of the great dependence on water transportation. It is favorable for foreign commerce and provides greater safety for property than exists in locations further in the interior.

Foreign commerce. The foreign commerce of China has grown since 1911, but disturbed political conditions, poor and inadequate transportation, and taxes on the movement of commodities hinder it. Treaties forbid the export of several cereals, and embargoes may be applied to the exporting of food products during periods of famine. Imports are greater than exports, recently about double. The unfavorable balance is because China has borrowed and because of the investment of foreign capital in the country. The total foreign trade, ranging recently from 325 to 350 million dollars annually, is roughly half that of Belgium or the Netherlands. One fifth of the total trade recently has been with the United States, imports and exports being equally divided, while Japan had 15 per cent of each, and the United Kingdom 10 per cent. Hong Kong handles 17 per cent of the exports but not much of the imports. The German Reich supplies 10 per cent of the imports and buys half that proportion of the exports.

Raw silk and silk and cotton textiles are the leading exports, each class contributing about 20 per cent of the total exports. Tin, other minerals, raw cotton, tung oil, and hides, skins, and leather each supply 10 to 12 per cent. Cotton and cotton textiles are about a third of the imports and minerals and chemicals are each

about 20 per cent. Other leading imports are machinery, wool and woolen goods, and coal.

Shanghai handles about half of China's foreign commerce, being slightly more important for exports than for imports. The city has one of the best locations in the Orient and is one of the most important trade centers of the world. Canton, Tientsin, and the British port of Hong Kong are other important ports. Much of the trade of South China passes through Hong Kong, which also does considerable manufacturing. Since its establishment under British control it has captured much of the trade of Canton. A feature of many of the Chinese ports is that they are located inland, where they were placed to escape the depredations of pirates. Hong Kong has grown because the British, by establishing law and order in the areas controlled by them, attracted many Chinese merchants to the district. British vessels haul almost half of the foreign commerce of China.

THE OUTER PROVINCES

China acquired its outer provinces (Mongolia, Tibet, and Sinkiang) largely to control the caravan routes over which her merchants conduct a valuable trade in Chinese products, exchanging them for products from Siberia and Europe. (See map on page 602). With the building of the Trans-Siberian railway and the railways of Russian Turkestan and the recent establishment of motor transportation, these routes have declined in importance. The principal caravan route starts at Peiping and goes westward into Mongolia, where it divides, one branch going to Russia, the other to Turkestan. Isaiah Bowman says that it is estimated that 100,000 camels are used to transport tea from Kalgan into Siberia, and that the caravan trade employs 1,200,000 camels and 300,000 oxcarts. He says further:

> Mongolia is crossed by historic roads, important in both former and present commerce. Among the most important of the old roads is the one to Eastern Turkestan, the great Inner Asian trade route, the main com

munication between east and west. It has a total length from Peking to Kashgar of 3,500 miles. For much of its distance the road, which passes through deep and narrow gullies, can be used by a single line of traffic only. For hundreds of miles it winds through depopulated and untilled country. It crosses mountain passes 10,000 feet high. Here and there are well-watered oases with an abundance of vegetation, and with prosperous but sleepy towns. The road is slippery in wet weather and deeply ravined.[1]

The routes largely follow along the foot of the mountains, where alluvial fans result in a string of oases towns.

The outer provinces could support more people. There has been some migration of Chinese to Mongolia and Sinkiang to escape political turmoil in China. Progress in the settlement of these countries, however, is likely to be very slow. The entire region has extreme temperatures and is largely desert, except for a grassy margin where the monsoon rains strike Mongolia and Tibet on the east. There is much fertile soil and much might be accomplished with irrigation.

Mongolia is an arid plateau consisting chiefly of the Desert of Gobi, which is a series of rock-floored basins. Between Kalgan and Urga there grows a thick, short grass which makes good land for pasture. As a result most of the inhabitants are nomadic herders, who, in times past, spread both east and west, overrunning China and getting as far as central Europe. The great Wall of China was built to keep them out of China, but it was only partially successful. Various animals are raised, and many camels are raised simply for their hair.

Urga, the chief trading center, is connected with Kalgan by motor road. In the northern part the permanent settlements serve as trade centers with Siberia. Kiakta in Siberia and Maimachen in Mongolia are gateway cities and have warehouses and other facilities for handling the caravan trade.

Tibet is an isolated plateau, largely unexplored, from which foreigners have been excluded. Recently, however, it has been opened to British trade, and British influence and control are

[1] *The New World*, Yonkers-on-Hudson, World Book Company, 1928, p. 558.

gradually penetrating from the south. The passes giving entry to the region are high and difficult; those from India are impassable when it is snowing or raining heavily. It should be noted that this plateau is the source of several of the large rivers of southeastern Asia.

For the most part the people live along the river valleys of the south, chiefly the Brahmaputra and several of its tributaries, where rich soils under irrigation grow wheat, barley, pulse, fruits, and other crops. The north is not fit for permanent settlement, and nomadic herding prevails. The principal animals are sheep and goats and the yak, the latter a highly useful native animal. It is agile, endures cold, and can subsist on the tough wiry grass of the plateau. Butter is made from its rich milk, cloth from its finer hair, and ropes, tent covers, and other articles from the longer, coarser hair. It is used also as a beast of burden. The people of Tibet drink much tea from China, this being their leading import, and they exchange products from the yak for it. Gyantse and Yatung are the leading trade centers.

Sinkiang consists chiefly of the desert Tarim basin, which some authorities think is the cradle of civilization. The Kwen Lun Mountains are the southern boundary. Water is obtained in the alluvial fans at the foot of the mountains, and on both the north and south are strings of oases towns, through which caravan routes pass. Cereals, cotton, fruits, and other crops are grown under irrigation around all of the towns.

The leading trade centers are Kashgar, Yarkand, and Khotan. Kashgar is a meeting place of the trade routes from China and from Russian territory. The other two are concerned more with the trade with India. All three cities are in fertile districts and have a prosperous agricultural industry around them.

CHINA AND HER NEIGHBORS

Industrially and commercially China seems to be the "sleeping giant" that she has been called. Unexploited mineral wealth and great potential markets have attracted industrial nations, which,

through increasing economic penetration and political domination, have squeezed the country as in a vise. In this game, strong contiguous countries have the advantage, and in this case Japan is decidedly in the strongest position. Japan and the U. S. S. R. are industrializing, and both need markets, while the former also needs foodstuffs and raw materials which China has to offer. One method of obtaining these is to gain control politically and then exclude other nations with protective tariffs. Because of location Japan and the U. S. S. R. are traditionally antagonistic. This antagonism is now bursting forth over the question of political influence in China, that country having to serve as a battleground as a result.

40

THE INDIAN EMPIRE

Area and population. The Indian Empire is about the same size as Europe, excluding Russia, and has about 90 per cent as many people. Population density is 202 people per square mile; Bengal, with 575 people per square mile, is the most densely populated of the provinces; the Ganges plain has 700. Almost 75 per cent of the area and 85 per cent of the people are in the British Provinces; the remainder are in the Native Indian States, which govern themselves, individually, except in matters that apply to India as a whole.

There are numerous ethnological and religious groups, chiefly of the white race, except in Burma, where the people are largely Mongolian. The elements of population in the main part of India owe their origin largely to invasions from the northwest. There are few Mongols, because of the effectiveness of the Himalayas as a physical and racial boundary.

Two thirds of the people embrace Hinduism, whose chief feature is the caste system, which has done much harm by keeping large numbers in a state of subjection. About 20 per cent are Moslems, and most of the remainder Buddhists, the former being largely in the dry northwest, the latter chiefly in Burma and Ceylon.[1]

Geographic features. India may be divided into four natural regions: (1) the Himalayas and associated ranges, (2) the Indus-Ganges-Brahmaputra plain, or Hindustan, (3) the peninsula, and (4) Burma.

[1] Ceylon is physically and economically similar to near-by parts of India but is governed separately from India.

The *Himalayas* extend all along the northern edge of India, and southward extensions separate Baluchistan and Burma from the remainder of India. This mountain system is composed of high, parallel ranges of folded sedimentary formations. There are several important passes, all at high elevations, which are used for the passage of trade with the countries to the north and west.

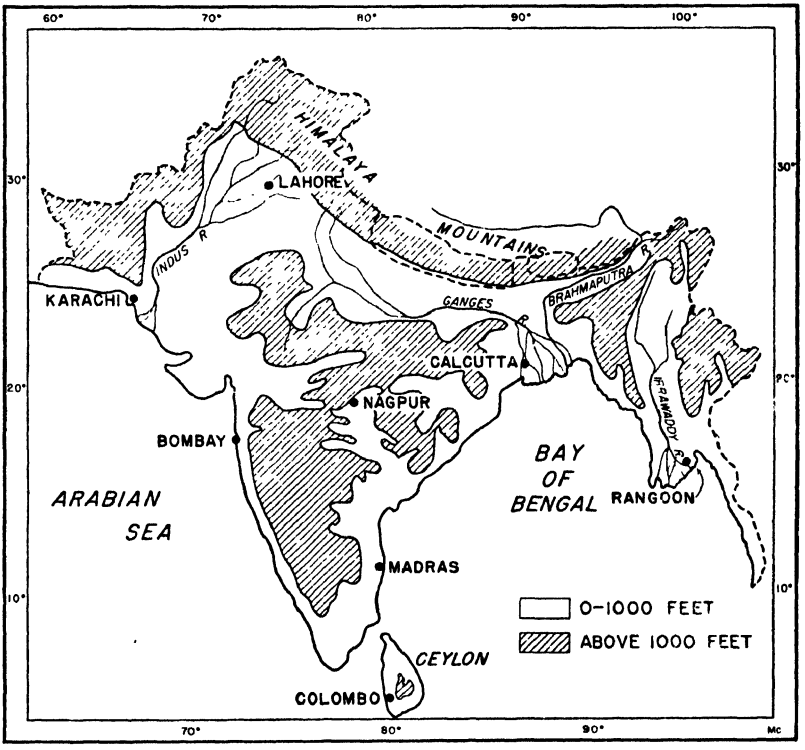


Fig. 215. Natural divisions and leading cities of the Indian Empire.

The most important are the Khyber and the Bolan Passes, both in the northwest. The former has an elevation of about 3,800 feet and controls the strategic route between Turkestan and India. Though in Afghanistan, it is controlled by the British. The Bolan Pass is near the seacoast and now has a railway extending through it to the west. The Karakoram Pass in Kashmir, through a mountain range of the same name, connects India with Turk-

estan via Yarkand. Farther east are passes leading to Lhasa, and through Burma to China.

Hindustan is a fertile alluvial plain, the alluvium being hundreds of feet thick over most parts. There are no rocks or elevations, and the land is easily cultivated. At the lower end is the greatest delta in the world and India's greatest agricultural district, although a portion is swampy. The upper part of Hindustan (the upper Ganges and the Indus Valleys) is much farther north and drier than the lower part.

The Ganges, the main river, is one of the most used of rivers. It varies from 1 to 2 miles in width as far as 1,000 miles from its mouth, and is about 30 feet deep. Throughout this distance its fall is less than 6 inches per mile, and near its mouth, only about 2 inches. In July, in its lower reaches, it spreads to as much as 100 miles in width and is 60 feet deep. During the monsoon season the delta is really a large lake. The Ganges is a sacred river to the Hindus, the most sacred spot being a small tongue of land at Allahabad, where the Jumnia River joins it.

Peninsular India is a mountain-rimmed, dissected plateau of old, crystalline rocks, with the higher, bolder face toward the west and a long slope to the east, and is higher in the south than in the north. On the north a series of mountain ranges makes an effective boundary between the peninsula and the Ganges lowland. The dissected western edge is called the Western Ghats Mountains, the eastern edge the Eastern Ghats Mountains. There is a coastal plain on both the east and the west, the one on the east being the broader because the rivers flow eastward across the peninsula. The southern end, the western coastal plain, and the Western Ghats have heavy rainfall. On top of the plateau rainfall is uncertain and light. The plateau has on the whole a savanna type of landscape. The greater part has a laterite soil, but the northwestern area is one of the largest lava plains in the world; the lava has weathered into a black soil retentive of moisture. Structurally, Ceylon is a continuation of peninsular India.

Geographically, *Burma* is a part of Indo-China, but because of its political relations it is included with India. It consists of two mountainous regions, separated by the broad Irrawaddy Valley. The best and most densely populated part of Burma is the delta formed by the Irrawaddy and Salween Rivers. The former stream is navigable by large steamers for 700 miles or more. Some of its tributaries are also navigable. The highlands of Burma are rich in minerals. On the whole the country is sparsely populated and for this reason is an important exporter of food products.

India on the whole has a poor coast line. Deep water and a few good harbors are found on the west side of the peninsula. Communication with the hinterland, however, is somewhat difficult there. On the east side of the peninsula the water is shallow, so that Madras, the second-ranking seaport, has an artificial harbor. There are a few seaports on the Ganges delta, but the difficulties usually encountered in establishing ports along a low swampy plain are met. The west coast of Burma has good harbors, but no real need for large seaports exists there, since the river valley is the heart of the country.

Climate. India has the tropical monsoon type of climate. It is very dry during the winter except on the slopes of the Himalayas and in the southeastern part of the peninsula and in Ceylon. The arid northwest also receives its rainfall in winter. The temperatures are high during the summer, and the Himalayas cause mild winter temperatures, preventing the cold winds that prevail over China from reaching there. The greatest extremes are in the arid northwest, where the seasonal differences in pressure have an important control over the general direction of the seasonal winds. The actual direction of the winds is controlled largely by topography.

There are three seasons: (1) the cool, dry season between the end of October and the end of February; (2) the hot, dry season, which usually ends about the middle of June; and (3) the rainy season from the middle of June to the end of October, the region

of highest temperatures then being the arid northwest. Since the rains come at frequent intervals, the intervening periods allow time for planting and working the crops. During this season the low-pressure area in interior Asia, augmented by the local low-pressure area in northwestern India, causes the trade winds to reverse themselves and to blow into India. Being warm, and having blown over the ocean for long distances, these winds bring tremendous rainfall whenever they are forced to ascend. The heaviest rainfall in the world is in the mountains of Assam, where there is 40 feet annually. The monsoon rains, however, are not always certain, and sometimes they are too late to make good crops. After the southwest winds (after crossing the equator the southeast trades are turned to their right by the rotation of the earth) cross the Western Ghats, they go down across the peninsula as drying winds. This area is poorly watered and subject to droughts which cause serious famines. In November and December, with the cooling of the land, the pressure conditions begin to reverse themselves, and the winds to blow outward from the land, gradually getting stronger and becoming the northeast trades. Sailing vessels traveling the northern part of the Indian Ocean try to arrange their schedules to take as much advantage as possible of the monsoon winds.

Forests. About one seventh of India is in forests, more than half of which are in Burma. Forty per cent of the area is under the control of the government, which regulates exploitation carefully. Variations in rainfall and elevation result in many species of trees; there are mangrove in the low swampy locations and equatorial forest where the rainfall is above 80 inches; the teak and sal trees grow in the monsoon regions with the dry, hot season, during which the leaves are shed; and the evergreen oak and conifers are found on the cool, moderately watered slopes of the Himalayas.

Everywhere the forests are an important source of domestic fuel. The principal commercial tree is the teak, chiefly from Burma, which is strong and resists the attacks of white ants. It

is, therefore, good for railway purposes. Unlike oak, it contains an oil that prevents rust when in contact with iron; this quality makes it excellent for use in ships. Sandalwood, also from Burma, is used for railway ties and for making novelties and ornaments. Large inaccessible reserves of timber remain in the Himalayas. Another product from the forest is lac, the secretion of an insect, which is used for shellac.

In lumbering, the trees are cut during the dry season and the logs assembled at streams to await the rainy season for transportation to the sawmills. Elephants are used much in moving the heavy timbers.

Minerals. Though not richly endowed with minerals, India possesses moderate-sized deposits of a few kinds and scattered supplies of several others. Coal comprises one third of the total production, petroleum a quarter, and gold and salt 8 and 6 per cent, respectively. The most important mineral areas are the northeastern and the southeastern regions of the Deccan upland and the highlands of Burma.

The chief coal district is on the edge of the Deccan upland northwest of Calcutta (Fig. 214). Not of good quality, the coal is nevertheless good enough to be used to smelt the iron ore which is near. As a result Jamshedpur is becoming an important industrial center. The manufacture of tin plate is important, for it is used to make containers for petroleum from the fields of Burma and Iran. India ranks high in the production of manganese and mica, the former being mined chiefly in the central part of the peninsula, the latter largely in the iron and coal area to the northwest of Calcutta, but also near the coast to the north of Madras. There are important deposits of magnesite to the south of Madras. Gold is also mined in the southeast, chiefly at Kolar. Burma is better supplied with minerals than any of the other parts of India. There is coal in the north, petroleum in the valley south of Mandalay, large deposits of silver-lead ore near Bawdwin and Heho, tin ore at Tavoy, gems at Mogok, and tungsten ore in the district where Burma, Siam, and the Malay States meet.

Agriculture. The people of India are farmers, often living in villages; only 10 per cent of the population is classed as urban. Methods of agriculture are similar to those of China and therefore will not be described in detail here. The many crops show a careful adaptation to conditions of climate and soil, but the systems of rotation do not seem to be so highly developed as in China. Famines due to drought have been common, but this problem has been partially solved recently by the building of railways and motor roads, which make exchange possible among the different sections. The British sponsored the building of the railways largely on this account.

Sometimes the monsoon rains fail altogether; at other times they are below normal, and during any one year they may vary much over the country. When they fail, even though the people may obtain food, there is a heavy loss of livestock, particularly cattle. Because of the uncertainty of the rainfall, India has built extensive irrigation facilities, which serve more area than in any other country. They are restricted mostly to the dry northwest, where a third of the land is farmed in this manner. Both canals and wells supply the water in this region. Wells are economical in some places because the ground water is near the surface. In the dry peninsula, where rainfall is most uncertain, there is also irrigation. Much of it is from small reservoirs built to trap water; when these become filled with silt, they are turned into farm land and others are built.

Indian agriculture is characterized by the importance of food crops for domestic consumption (Fig. 216). Income would, of course, be greater were more money crops grown, particularly cotton and wheat; but these require added outlays for irrigation facilities. Sufficient water is available to irrigate a much larger acreage, whenever the facilities are provided.

Cereals comprise the leading group of crops: rice and millet for domestic use, wheat and barley largely for export. Though rice is grown everywhere along the coastal lowlands, the great rice district is the Ganges-Brahmaputra delta, where 75 per cent

of the land is in the crop. A lesser district is the Irrawaddy delta and valley, two thirds of the cultivated land of Burma being planted to rice. It is the leading export from this section, much being sent to other parts of India. Several varieties of millet are grown on the less fertile, dry soils of the peninsula and in the upper Ganges Valley. Winter wheat is grown in the dry northwest, half of the acreage under irrigation, and increasingly in the peninsula, where it occupies the more fertile soils. Barley is grown in the Ganges Valley between the main rice and wheat districts, overlapping into the latter considerably.

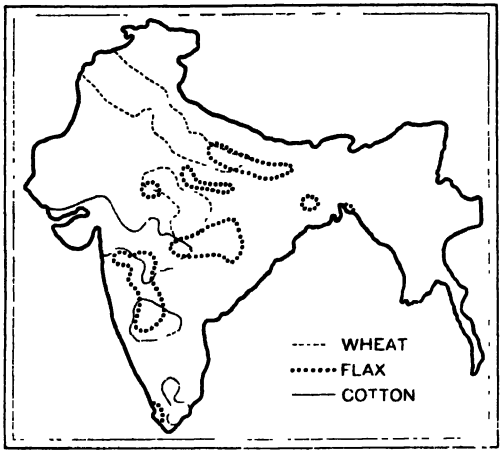


Fig. 216a. Principal producing areas of the leading crops of India.

Plants producing oil-seeds (rape, mustard, peanuts, sesamum, flax, castor) comprise the next important group. The oils obtained by crushing are used both for food and for industrial purposes and are an important export. These crops are grown widely, the different kinds making adaptation to different conditions possible, and replace the staple crops on poor soils and in dry districts. Although several are grown in the Ganges Valley,

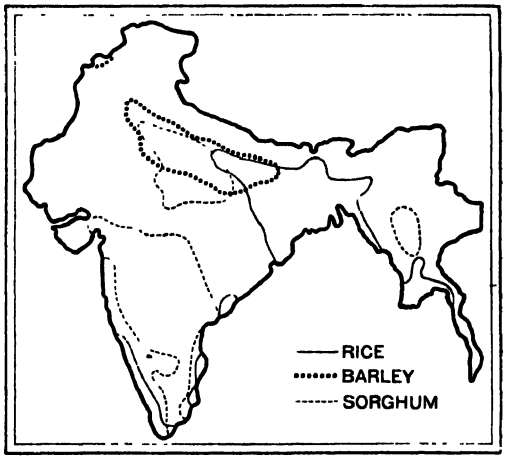


Fig. 216b.

the dry plateau and the east coast are the most important sections for oilseeds.

Sugar cane, in the production of which India leads the other countries of the world by far, is grown, largely under irrigation, in the same general region with barley. The cane is grown in small plots and crushed at near-by mills, and the juice is made into a crude raw sugar called "gur."

There is a considerable production of coconuts and spices on the wet, hot coastal lowlands of the south and west, and of coffee, tea, and cinchona in the highlands of the south; were there sufficient demand, the output could be increased. The tea industry is so important that it will be discussed later in a separate section

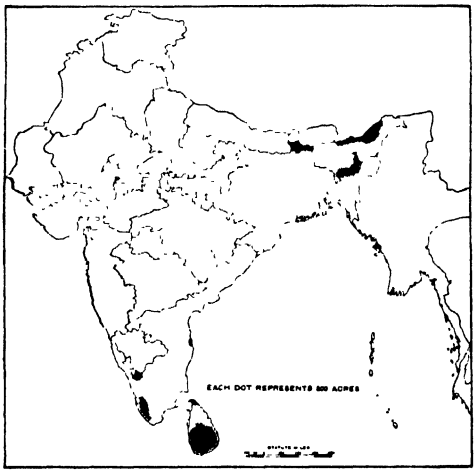
In scattered places, but chiefly at Rangpur, where some of the crop is grown under irrigation, India produces almost as much tobacco as the United States. Although the growing of bright-yellow cigarette tobacco has recently been established and is expanding, most of the tobacco grown is of poor quality. Nearly all is used domestically.

India supplies two textile fibers: it leads the world in the production of jute and ranks next to the United States in cotton production, with an output about a third as great. The jute is grown in the Ganges delta, where the land is fertilized by the annual floods. Cotton, the leading money crop, would be much more important were scientific methods of production employed. The yield per acre is only half that of the United States, and the quality is poorer. The leading center of production is to the west of Nagpur on black, water-holding soils. It is grown also in other parts of the peninsula and under irrigation in the Punjab and Sind in the northwest, where there would be greater possibilities with added irrigation facilities.

Tea. The leaf of the tea tree gets its characteristic flavor from small oil cells, the stimulating quality being from theine, which is similar to caffeine in coffee. There are two varieties of tea trees, that of China, Japan, and Taiwan producing small leaves, that of India, Ceylon, and Netherland India producing large leaves.

The latter is a cross between the small-leaf tree and a large-leaf tree native to Assam. The tea of commerce is of two types, green tea and black tea; the latter results from fermentation, which drives off the tannin when the leaves are piled in heaps. Since the geographic and economic requirements for successful tea production are similar to those for silk, they need not be repeated.

Ceylon is the best tea region in the world. In India the leaves are harvested every 10 days during the summer monsoon, about 500 pounds per acre being obtained annually. This is equal to the yield in Japan. Because Ceylon gets the benefit of the moist monsoon winds from both directions, with therefore both summer and winter rain, the leaves of the tea trees there are picked every two weeks throughout the year, and the yield is about 1,000 pounds per acre.



U. S. Department of Agriculture

Fig. 217. Regions of tea production in India and Ceylon.

The tea is grown on plantations owned chiefly by corporations and managed by the British. The plantations of Ceylon average about 300 acres in size, and there is, on the average, one worker per acre. India is now the world's leading producer and exporter of tea, and Ceylon ranks second. The industry was established about 1850, when the trading monopoly of the East India Company expired. The rapidity of development in this industry is due to the production of the large-leaf variety, which has a stronger flavor than the small-leaf variety. It has come more into favor in recent years. The duty into the United Kingdom, which purchases more than 50 per cent of the tea entering into international trade, is lower on colonial than on foreign teas.

Animals. India has millions of animals, which have an important place in the national economy. None of them are used much for food, however, and they are not of a quality that would make good meat. There is also relatively little dairying, for the animals are grown for draft purposes and for their hides and skins, which are a leading export. Swine are not raised, because of religious beliefs, and for the same reason cattle are not eaten.

Cattle, buffaloes, and goats are widely distributed, but are concentrated where population is densest. India leads the world in the number of cattle, but they are not the European type of animal. There are several different types, a familiar one being the long-horned animal seen in rodeo shows. The southeast part of the peninsula is the leading sheep region and also has many goats. Camels in the dry northwest and elephants in Burma do some of the heavy work.

Manufactures. Because of India's importance as a market for their manufactured goods, the British have never favored the rise of manufactures. Among the Indians themselves, however, there has been an inclination to develop their own manufactures. Favoring this are excellent commercial location, a considerable amount of raw materials, and cheap labor; cheap fuel, capital, and skill and experience, however, are lacking. The latter two may be acquired; the scarcity of fuel might be overcome with the development of hydroelectric energy, of which there is an estimated total of 27 million potential horsepower. A great deal of the water power, however, is in the inaccessible Himalayas. The present manufactures are either cheap, coarse products or agricultural commodities that require processing.

The leading industry is the manufacture of textiles, chiefly cottons. There are 20 per cent more spindles than in China, or a number almost as great as the combined totals of North Carolina and South Carolina. Bombay, near the cotton-growing district, is the principal center, but Madras, Nagpur, Gabalpur, Cawnpore, and Allahabad, the last a great railway center, also have factories. All obtain coal from the field on the northeast corner

of the plateau. Calcutta and near-by places employ two thirds as many people in jute factories as Bombay employs in cotton mills. Considerable silk for domestic use is manufactured in Bengal and also in the Himalayas, Burma, and the southern part of the peninsula. Carpets and shawls are typical woolen products, both being made in Kashmir, whose shawls of goats' hair are world famous, and carpets also are made in the upper Ganges

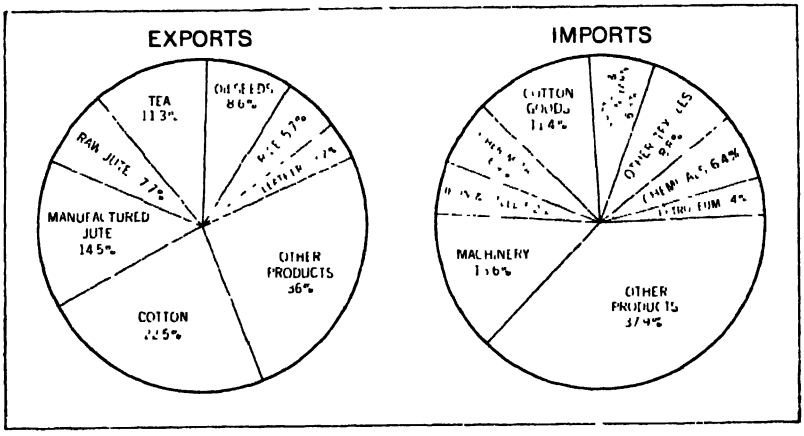


Fig. 218. Principal items in the foreign commerce of British India, 1936.

Valley. Cawnpore and Madras manufacture leather goods, and Luchnow makes articles of gold and silver, for which there is a great demand in India. The rising iron and steel industry of Jamshedpur has already been mentioned. The largest steel-manufacturing unit in the British Empire is located there.

Foreign commerce. India supplies large quantities of raw materials for manufacture and is an important buyer of several manufactured goods. Exports are usually greater than imports. Recently, the United Kingdom has taken 30 per cent of the exports and has supplied 40 per cent of the imports. These are important reasons for England's not encouraging manufactures in India and for possessing the country. Japan, whose exports to India have recently caused a decline in Indian purchases from the mother country, has of late shared about 16 per cent of both

imports and exports, and is followed by the United States and the German Reich.

Bombay, whose importance increased with the building of the Suez Canal, and Calcutta handle the major share of the foreign trade of India. Other important ports are Karachi, Rangoon, and Madras. Bombay, situated on one of the best harbors in India, is the leading port; 60 per cent of its business consists of imports. In all the other important ports except Madras, where imports and exports are equally divided, exports exceed imports. The exports at Bombay are chiefly cotton and oilseeds. Calcutta is almost as important as Bombay, with jute and tea as important exports. Karachi handles the wheat and cotton from the Punjab and Sind, and through Rangoon flows nearly all of the trade of Burma; most of the exports, however, go to India. Rice, oil, and teak are the leading exports. In Ceylon, Colombo, a coaling station for ships and one of the leading entrepôts in the Orient, cares for most of the trade.

Economic problems of India. Because it is the leading single market for British manufactures, India is Great Britain's most desirable possession. Furthermore, India is a strategic link in the great British "life line" to the Orient. Control of the sea routes and harbors, made possible by the possession of India, is necessary if the British are to maintain a hold on their entire Asiatic trade.

The standard of living in India is low because of a dense population, frequent crop failures, inefficient utilization of resources, and burdensome land taxes. The development of manufacturing, for which India has the physical base, but for which she lacks capital and skilled workers, would probably raise the standard of living, but the British have never actively encouraged manufacturing there. However, the British, in providing capital and technical skill for the construction of transportation and irrigation facilities and for agricultural research, have alleviated the economic problems of India by making crops more certain and more productive and by making possible added exports.

41

SOUTHEASTERN ASIA, THE EAST INDIES, AND THE PHILIPPINE ISLANDS

IN this chapter are included the remaining parts of the peninsula of Indo-China and the islands off the southeastern coast of Asia. Politically, the region is divided into British Malaya, Siam, French Indo-China, Netherland India, the Philippine Islands, and a few other British possessions (Fig. 219). Siam is an independent country with British and French spheres of economic activity. As was stated previously, the Philippines are under the control of the United States but according to present plans are to become independent in 1946.

Because of their similarities in structure, climate, people, and economic activities, it seems reasonable to discuss these lands together in this chapter.

Area and population. The combined area of these countries and islands is one third that of Europe, and the population is one fifth as much. About 55 per cent of the land and 60 per cent of the people are in Netherland India; Java, with only 3½ per cent of the land, has 40 per cent of the people.

Easy movement by water has brought about several races of people, of which the Malays are predominant. Mountain ranges separating valleys and lowlands have caused separate groups and states in several places. In Borneo, for example, savages inhabit the interior, while Malays do the farming near the coast, and the Chinese, who control trade and commerce throughout the region, carry on trading.

Geographic features. The structural features of the mainland portion are only extensions of those in adjacent areas, and the

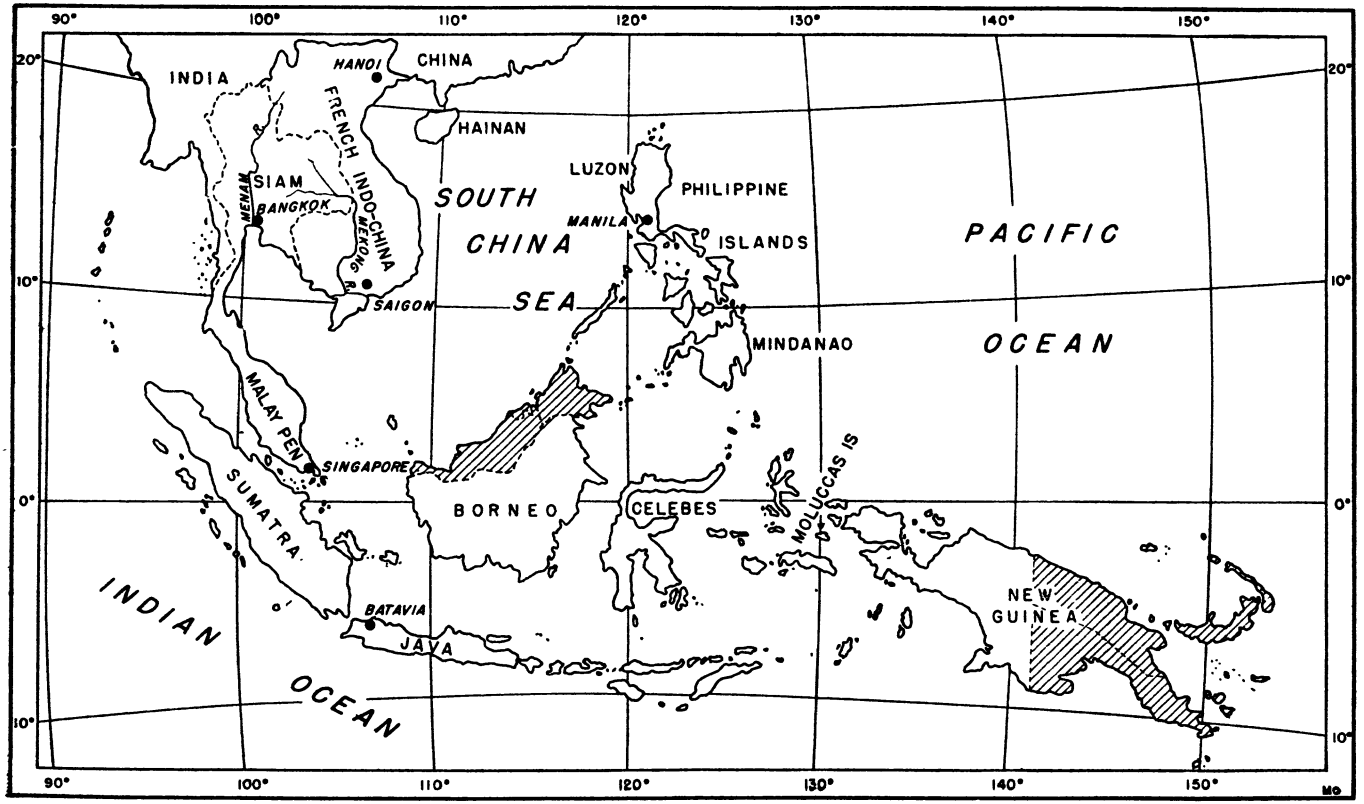


Fig. 219. Southeastern Asia, the East Indies, and the Philippine Islands. The British portions of the islands are hatched.

same features prevail in a majority of the islands. All of the islands except Borneo are volcanic, and Java has more volcanoes than any other equal area in the world. The fauna and flora of the eastern islands are different from those of the western. New Guinea is thought to have been connected with Australia at one time.

Climate. Most of the peninsula of Indo-China and the Philippines have a monsoon climate; the summer monsoon provides most of the rainfall, although in some areas the winter monsoon also is somewhat rainy. In the peninsula of Indo-China rainfall

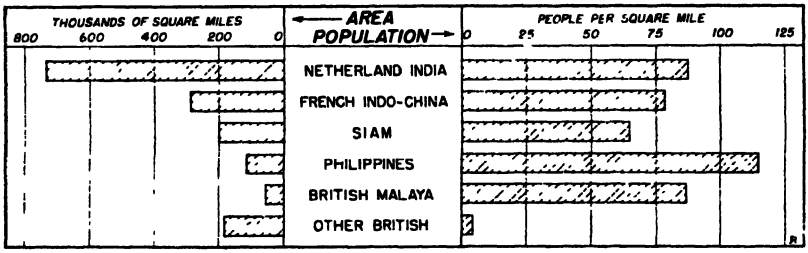


Fig. 220. Area and population per square mile of the main divisions of Southeastern Asia and the East Indies and of the Philippine Islands

is about equal to that of southeastern China; in the Philippines it is heavier. The Malay Peninsula and the East Indies have the tropical rainy type of climate. The lands toward the outer edges are adapted better to human development than those near the equator, because they have a more marked dry season (Fig. 221) and some have lighter rainfall. Because of these conditions, the forests are less dense than they are nearer the equator, and various crops can be grown.

Forests. Nearly all parts of this area are heavily forested, but the woods have limited uses because they are tropical species. Teak, of most significance, is cut under British management in upper Siam. The logs are floated down the streams, to be exported through Bangkok. At present lumber is the leading export from Borneo. It is also an important one from the Philippines, where there is an immense wealth of tropical woods, nearly all of which is owned by the government.

Minerals. These lands have important deposits of a few minerals and scattered deposits of others that later may prove to be valuable, and fuller exploration may disclose others.

The Malay Peninsula, Siam, and the islands of Banka and Billiton produce about 60 per cent of the world's tin. The mining is done by placer methods with Chinese labor, and the ore is smelted both by crude Chinese methods and in European-owned

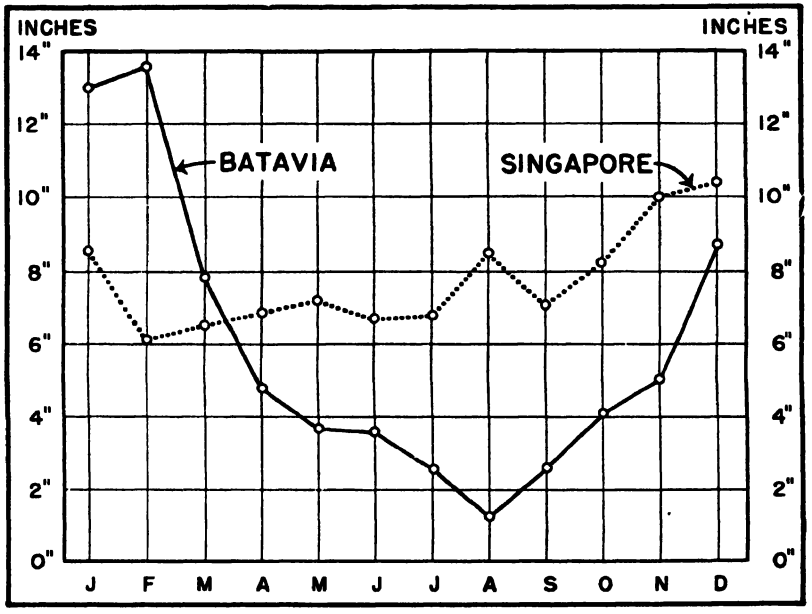


Fig. 221. Mean monthly rainfall of Batavia and Singapore.

smelters. British Malaya and Siam also have important deposits of tungsten.

Extensive deposits of petroleum are worked in Java and Borneo and supply a much needed product to the region. The annual output recently has been slightly greater than that of Mexico.

Gold, probably more widely distributed than any other mineral, is the leading ore mined in both New Guinea and the Philippines. The inaccessible mining district in the former is served by air transportation.

Deposits of coal likewise are scattered, and are mined in the

Philippines, various of the islands of Netherland India, and at Labuan in Borneo, the latter supplying fuel for British warships stationed in this area.

The Philippines and New Caledonia contain deposits of chromite ore, and the latter has deposits of nickel and phosphate rock. Several other near-by small islands have reserves of phosphate rock, which in the future may be important for Australia and the densely populated lands of Asia.

Agriculture. These countries grow a variety of tropical products for both local consumption and export, the latter being

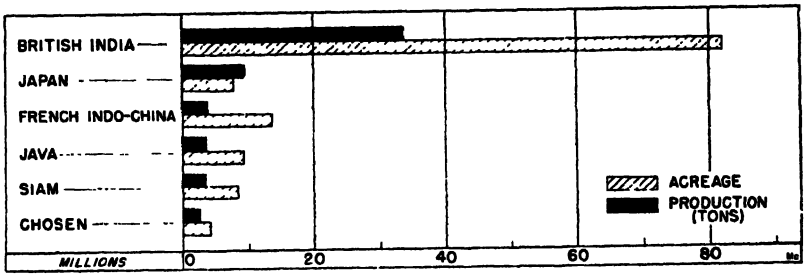


Fig. 222. Acreage and production of rice in the leading producing countries in 1934. (Figures for French Indo-China are for the year 1932-33.)

mainly tree crops produced largely on plantations owned and managed by Europeans. A large part of the world's tropical plantation agriculture is in these lands. Since European control assures stable government, capital is attracted; dense populations with low standards of living and accustomed to hard work provide cheap labor, and the island and peninsular nature makes transportation easy and cheap. This combination of advantages is not found in other parts of the tropical world.

For purposes of discussion, the crops will be divided into two groups—field crops and tree crops.

Field crops. The leading food crop is rice; others are sugar cane, corn, and manioc. Rice is grown widely, attaining most importance in Java and the Philippines, both of which must import to meet food requirements, and in Siam and French Indo-China, which, with Burma, comprise the leading rice-exporting

region of the world. About half of the cultivated land in Java is in rice. There the Dutch control the acreages in various crops in order to stabilize the food supply; otherwise too many money crops would be grown. In the Philippines many of the mountain slopes have been terraced to grow the crop.

Siam and French Indo-China have good natural conditions for rice, relatively sparse populations, and good location with respect to markets. Siam is mainly a lowland that includes about half of French Indo-China. Because of sparser population the crop is grown with less care than in China or India, and a considerable acreage is of the upland variety. The producing districts are mainly in the hinterland of Bangkok and Saigon, which, after Rangoon, are the leading rice ports of the world. A smaller district is in the delta of the Red River, Haiphong being the port. More than half of the crop of both countries is exported.

Corn ranks next to rice as a food throughout most of the region. Java grows about 60 million bushels annually and the Philippines about 15 million bushels.

Manioc, the starchy root of a shrub native to tropical America, is an important article of diet throughout the tropical world and is the source of the commercial product, tapioca. The root, about two inches thick and a few feet in length, requires from 6 to 9 months or longer to mature. When young, it may be prepared like potatoes; older roots are dried and ground into a meal resembling corn meal. In Java, where the volcanic soils seem to be particularly suited to it, manioc occupies a third as much acreage as corn. It is easy to cultivate but exhausts the soil.

The growing of sugar cane is important both in Java, which ranks next to Cuba as a commercial producer of the crop, and in the Philippines, where sugar cane ranks next to rice in value and first as an export, and in southern French Indo-China. In the islands the crop is grown by corporations. In Java, a company wishing to build a *central* obtains a concession from the government, which gives the company the right to lease land from the natives under long-time contracts, but only one crop of

sugar cane can be grown in 3 years; the land must be in rice the remainder of the time. Considerable American capital has been invested in the Philippines, and the industry might be more important were the markets of the United States not so distant.

The Philippines, Sumatra, Java, and Borneo grow tobacco, chiefly of the cigar types. The leading district in the Philippines is along the Cagayan River on the island of Luzon. The quality is best where the river overflows annually and deposits a layer of silt. A second area is around the Gulf of Lingayen. Much tobacco is consumed domestically, but about half of the crop usually is exported in the manufactured form. Cigar making is a leading manufacturing industry in the Philippines.

Sumatra and Java grow good wrapper leaf, that of Sumatra being the best in the world. Its elasticity and thinness give it considerable more covering capacity than any other type of wrapper, while the light color, smoothness, and good burning and blending qualities make it further desirable. This tobacco is grown on large European-owned estates with labor recruited chiefly from Java. A contract labor law that prevails in the Dutch possessions makes a rigid control of every operation possible, and the industry consequently has reached a high state of development.

Tree crops. The leading tree crops are rubber and coconuts; other important ones are abaca, tea, spices, and quinine. Rubber may be obtained from the latex of about 500 different species of plants. The species of tree from which most rubber is obtained does best on fertile soils in regions with a minimum annual rainfall of 80 inches, an average temperature of 80° or higher, and an absence of winds. The yield also is influenced by the quantity of air and light that can circulate among the trees, the latter being especially important because the tree absorbs most of its tissue-building material from the air through its leaves rather than from the soil. A few rubber-bearing plants have adjusted themselves to dry conditions, but they are unimportant commercially except when prices are very high.

Another prerequisite is a plentiful supply of cheap labor, for a majority of the operations involve human labor.

Before 1906, plantation rubber was less than one per cent of the total supply; now it contributes in excess of 97 per cent. The chief reason for the rapid development of the plantation industry was the inability of wild rubber to supply the demand after the automobile became important. Prices reached a maximum of about 3 dollars a pound in 1910. The abundant supply of cheap, docile labor is probably the main influence in placing southeastern Asia in the lead as a rubber producer. Another factor is the nearness of all parts of the region to ocean transportation. The plantations are also managed scientifically. All of these influences result in a cost of production so low that other places have not been able to compete.

British territory, chiefly the Malay Peninsula, produces 60 per cent of the world supply of rubber. The output of Netherland India has been increasing, one reason being that the recent Stevenson restriction plan, which applied only to British territory, encouraged the setting of trees in other places. Now another restriction agreement includes the possessions of both Great Britain and the Netherlands.

In establishing the plantation industry, the British experimented in their different possessions in this region and found Malaya to have the best combination of natural conditions. There is steady heat and humidity and rainfall of 100 to 200 inches annually with an almost daily shower of the monsoon. Such conditions produce a tree 60 feet in height in 3 years. The trees are planted in rows 15 by 20 feet apart, which places about 150 to the acre. If the plantations are on sloping land, measures to prevent soil erosion are necessary. A tree starts producing at about 5 years of age and will continue to bear for years if proper care is exercised. The yield from mature trees is about 400 pounds per acre annually. The tree may be tapped daily, but on the plantations it is usually given a rest of one day in seven. It may often be given a few years' rest. Workers gather the latex and take it to a

factory, where it is coagulated. It is then washed, dried, and cut into small pieces and run between rollers, from which it comes in long sheets. It is then dried again in a hot air chamber or a vacuum dryer and treated with smoke or creosote to prevent decay. Recently liquid latex has been shipped to manufacturing centers in tank ships, thus doing away with the necessity for coagulation on the plantation.



Goodyear Tire and Rubber Co.

Fig. 223. Rubber trees being tapped in Sumatra.

Other parts of this region have a few rubber plantations. There has been a gradual increase of large plantations in the southern Philippines, where the industry might be more important were there not land laws that limit the holdings of foreign corporations. The natives own 96 per cent of the cultivated area of the Philippines in farms that average about 6 acres in size. French Indo-China has plantations north of Saigon, and several of the islands have established the industry.

The East Indies and the Philippines together lead the world in

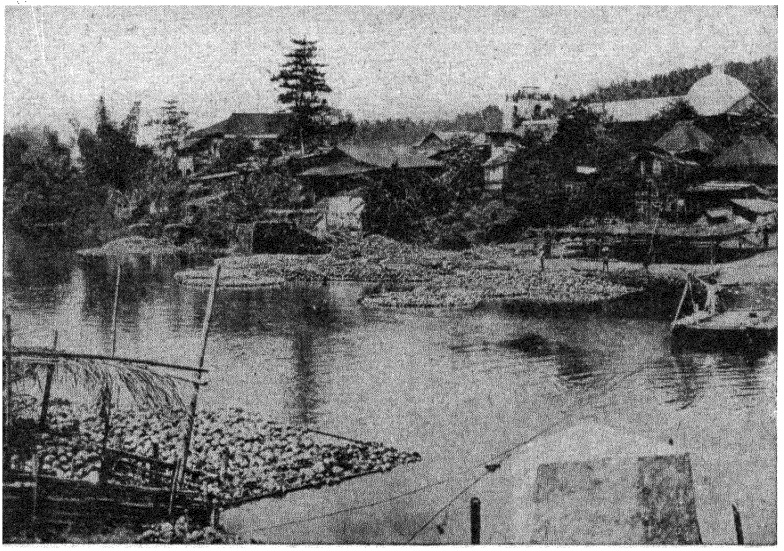
the production of coconuts and their products. They produce 80 per cent or more of both copra and coconut oil. Coconuts grow wild along the coasts of all the islands and in many parts of



Bu. of Insular Affairs, War Dept.

Fig. 224. Coconut tree with over one hundred coconuts on it, Mindanao, Philippine Islands.

the interior. The industry is largely in native hands, although there are some plantations operated by Europeans. The Philippines have $150,000,000 invested in plantations which employ 4 million people. Netherland India usually supplies 40 per cent of the world production of copra, the Philippines 20 per cent, and British Malaya 16 per cent; the Philippines contribute 50 per cent of the coconut oil, and Netherland India supplies 17 per cent.



Bu. of Insular Affairs, War Dept.

Fig. 225. Coconut market on the Pagsanjan River, Laguna Province, Philippine Islands.

Much of the oil from the latter is extracted in the Netherlands near the markets. Copra is about 65 per cent oil, and about 55 per cent of its total weight is extracted in oil. The remaining oil and cake make a good cattle feed, for which no market exists in the Orient. Furthermore, the oil must be shipped in containers, and a tropical wood suitable for barrels has not been found.

The production of tea is increasing gradually in the islands, and Java now has a thriving industry located on volcanic slopes. The Netherlands is the principal market, but a growing trade has been developed with Australia, and a considerable amount is sent to the United States.

Spices, once valuable and relatively important in world commerce, are now relatively cheap and only of minor commercial importance. Although they still serve an important need, refrigeration and improvements in the culinary arts have made them less necessary than formerly. Their production is largely in Netherland India. Pepper, the leading spice, is from the berry of a native creeper and is grown in gardens by the natives. The leading market is Batavia. Other spices are nutmeg, cloves, and cinnamon from Netherland India and ginger from French Indo-China.

Ninety-nine per cent of the world's supply of quinine, which is obtained from the bark of the cinchona tree, a native of the northern Andes, is produced on plantations in Java. The industry seems to have been first transplanted to the Orient because the government of India saw the necessity for quinine in combating malarial fever, which is widespread, and because the wild sources were not dependable.

Abaca, or Manila hemp, a relative of the banana plant, has a hard fiber (true hemp has a soft fiber) noted for its strength, durability, and ability to resist the action of salt water. The plant requires a warm climate with regular rainfall the year round, for drought is fatal. Five or six hundred mature trees per acre, depending on their size, will return from 1,000 to 3,000 pounds of fiber annually. Because of the ease of growing it, abaca is the money crop of small farmers in districts where it is grown. However, a considerable amount of exhausting, tedious hand labor is necessary to split the fibers and to remove the pulp from them. The pulp is removed by drawing the fibers across a knife placed over a smooth block of wood. One man can prepare about 13 pounds of good fiber or 50 pounds of poorly cleaned fiber in a day. Until recently the Philippines almost monopolized the crop; now the production is spreading to other districts, which grow an inferior product. The Filipinos use the fiber to make fabrics, slippers, chair bottoms, and hammocks; the Japanese make paper of it, while in the United States worn-out ropes of

abaca are used to make Manila paper and to caulk the seams of vessels. Almost the entire production is exported to the United States.

Other crops. There are several other crops, only a few of which can be mentioned. Pineapples, which are canned and exported at Singapore, were once more important than now. Raw silk is produced along the eastern coast of French Indo-China, and only scarcity of skilled workers prevents expansion of the industry. There are important cotton-growing possibilities in both Siam and French Indo-China, and this region may in time supply

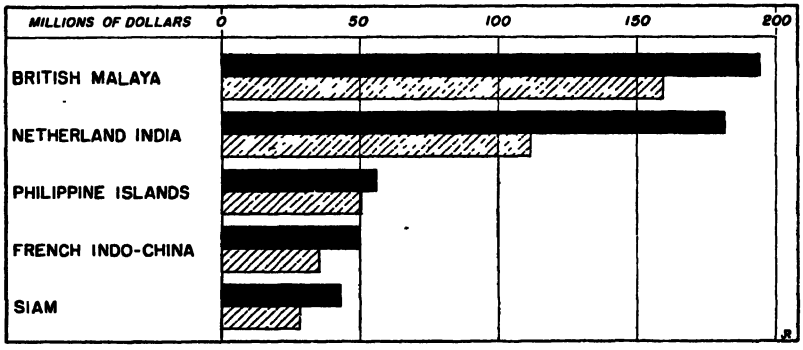


Fig. 226. Volume of exports and imports of the different political divisions in 1935. Exports are the black bars.

much of the Japanese demand for raw cotton. At present, floods, labor difficulties, and the lack of transportation are obstacles.

Foreign commerce. The commercial importance of the lands included in this chapter is shown by the fact that their combined foreign commerce (Figs. 226 and 228) is normally somewhat in excess of that of Japan. Although some products, notably foodstuffs, are exchanged among the various divisions of the region, the bulk of the trade is with the mother countries and Japan. In 1935 the United States purchased 28 per cent of the total exports of the region and ultimately obtained more through entrepôt trade with the United Kingdom and the Netherlands. The United Kingdom, the Netherlands, Singapore, and Japan each purchased about 9 per cent of the exports, and Hong Kong 5 per cent. The

exports to Singapore went to many other countries, that city being merely the collecting center, but those to Hong Kong went mostly to China. Since the rise of cotton manufacturing in Japan, that country has come to dominate the importing of the region, supplying 16 per cent of the imports in 1935; the United States contributed 12 per cent, the United Kingdom 10 per cent, Singapore 5 per cent, and Hong Kong 2½ per cent.

There are many seaports, but other than those named in the discussion of rice, only Singapore, Penang, Batavia, and Manila

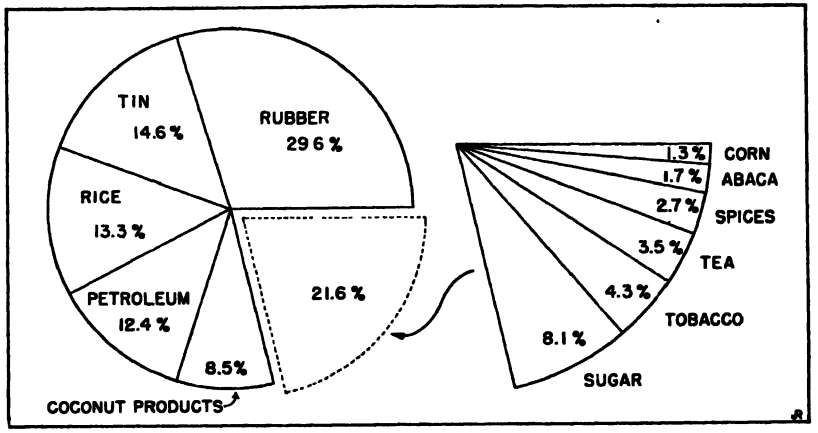


Fig. 227. Relative positions of the leading exports of Southeastern Asia, the East Indies, and the Philippine Islands in 1935.

are important. Singapore is the leading entrepôt in this part of the world, collecting and distributing products for the entire region. It has an excellent location at the meeting of various ocean routes and has grown because the British encouraged the Chinese in the development of a business organization that spreads throughout the region. The city also is a coaling station and is heavily fortified. Batavia is important only because of the industries of Java, and Manila because of location where several ocean routes meet.

Importance of British possessions. British possessions in the region of southeastern Asia are important to the mother country as places in which she can invest surplus British capital to pro-

duce raw materials for the home country to manufacture or re-export, thereby giving employment to factories, shipping companies, and middlemen. Furthermore, the British possessions are located strategically so as to give Britain control of important harbors and ocean routes.

Netherland India and the mother country. Netherland India serves the mother country commercially as the possessions of Great Britain serve her, except that it is relatively more important.

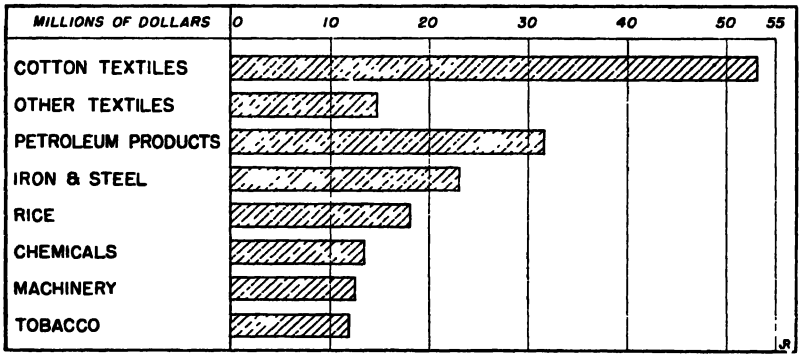


Fig. 228. Principal imports of Southeastern Asia, the East Indies, and the Philippine Islands in 1935.

However, only 6 per cent of the exports and 5 per cent of the imports of the Netherlands are with these possessions.

The Philippines and the United States. The Philippines serve the United States as a base from which to conduct trade with and to protect its interests in the Orient. Political, economic, and possibly altruistic motives now have caused us to grant those islands their independence. As was stated previously, unfavorable land laws have limited the investment of American capital. These laws and the long distance to the American market have retarded development. Nevertheless, in 1934 there were $258,000,000 of American capital invested in the islands. Independence may injure these islands economically, because they have long had free entry into the United States for their exports; with independence becoming final, this privilege will be lost. At present their exports to us are restricted by quotas, any quantities above the quotas

paying the full tariff duty. In addition, the independence act requires export duties beginning in 1941, the proceeds to be used for a sinking fund with which to retire the bonded debt of the islands. The United States now levies an excise tax on the imports of coconut oil and has placed a tariff duty of 20 per cent on foreign imports into the Philippines.

42

AUSTRALIA AND NEW ZEALAND

AUSTRALIA

AUSTRALIA, in area somewhat larger than the United States, has only as many people as New York City. It is thought that the land might easily support ten times the present population. Newness, isolation, aridity, and restrictions on immigration have retarded development. The Commonwealth has its white Australian policy which prohibits all but white immigrants, and of those there is a careful selection indeed. There are about 60,000 black aborigines, but since they are in scattered and isolated locations, they are of little concern to the remainder of the people. They are poor workers, but some of them are employed on the large ranches as herders and boundary riders and some are used by the police at times in trailing criminals. Ninety-six per cent of the white people are British, and land ownership restrictions apply in varying degree to all but native or naturalized British subjects.

Nearly all of the people are located in the coastal areas, and about half of them live in the six capital cities, 20 per cent being in Sydney, the largest city. These facts pertaining to the population distribution give us some hints as to the nature of the country and its relations with the rest of the world.

Geographic features. Though Australia is relatively flat, four topographic divisions are generally recognized: (1) the Great Dividing Range, (2) the Murray River basin and the various artesian basins, (3) the dry plateau of the west, and (4) the narrow coastal plain. The most scenic and conspicuous topographic

feature is the recently uplifted Great Dividing Range, which is made up of a series of disconnected elements of diverse origin. Within this highland area are many deep, fertile valleys and fertile high plains and plateaus, such as the Darling Downs of Queensland and the New England district of New South Wales, which are valuable grazing lands. The real importance of this mountainous area, however, is that it stands in the path of the southeast

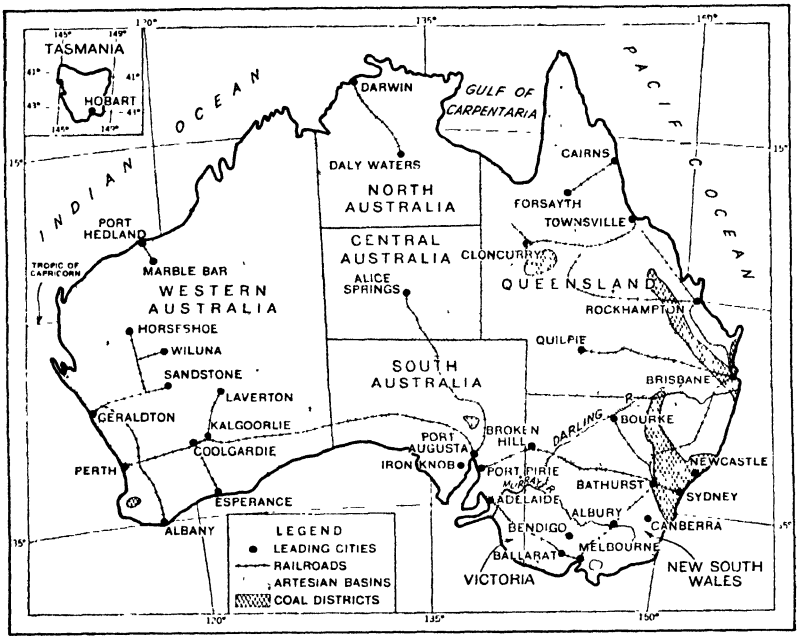


Fig. 229. The Commonwealth of Australia; Tasmania in inset. The artesian basins are adapted from the report of the Fourth Interstate Conference on Artesian Water.

trade winds, which blow over much of Australia, and thus takes from those winds, which otherwise would have nothing to cool them as they blow toward the equator, sufficient moisture to make the eastern coast a well-watered region. Tasmania is a separated part of these highlands.

West of these highlands is a belt of rolling plains about 300 miles in width, containing the basins previously mentioned. This is a fine grazing country, where are found the great sheep and cattle ranches. The Murray River basin also contains fertile agri-

cultural lands. Irrigation, however, is necessary over much of the district. The artesian basin to the north, containing 576,000 square miles, is a former arm of the sea. Artesian water is of great importance in providing water for livestock, and it may be used to irrigate large acreages of crops in the future. Queensland has 2 wells that have a daily flow of more than 2 million gallons and 16 with more than 1½ million gallons. There are about 1,200 artesian wells in Queensland, 63 being owned by the state and 16 by local governing bodies. South Australia has 142 government-owned wells.

The western plateau, comprising two thirds of the area of the country, is an ancient crust-block that is largely desert. Various sections have deposits of minerals, and exploration may result in the discovery of other supplies that are now unknown.

There are two narrow coastal strips. One is on the west, with a Mediterranean type of climate. The other, on the southeast, is an important section of the nation. It has minerals and is adapted to the growing of subtropical crops and to grazing.

Climate. The outstanding features of the Australian climate are aridity and mild temperatures. A third of the land has less than 10 inches of rainfall annually, and an equal area not over 20 inches; the east and extreme northern coasts have 40 inches or more, the heaviest being in the north, where monsoon conditions prevail. Most arid are the south-central and southwest sections. Rainfall is most reliable in the north and along the south coast and in the southern part of the highlands. The coastal region from Shark Bay to Melbourne has a Mediterranean climate. Grazing may be done where there is as much as 10 inches of rainfall, and wheat may be grown safely where there is 10 inches from April to October. Aridity in Australia is caused both by compactness of the continent and by its location in the belt of southeast trades.

Forty per cent of Australia may be called tropical. Low temperatures do not prevail anywhere, although during the winter nights they may fall to a few degrees below freezing anywhere

in the southern half. Snow is rare, though it occasionally falls in Tasmania, in the highlands, and in the southern area. The mean January temperature ranges from 65° along the south coast to 90° in a small area in the northwest, the isotherms in general running parallel with the coast. In summer the southern states occasionally have temperatures of 100° for a few days, but a change from a north to a south wind may cause a drop of as much as 40° within an hour.

On the whole the climate is somewhat similar to that of the southern United States; the south and the southwest are much like southern California, and Sydney is like New Orleans. Hobart has climatic conditions much like those of Chicago, except that its winter winds are not so bitter as those from Lake Michigan. Small area, elevation, and more southern location cause Tasmania to be cooler than the mainland.

Forests. Since forest wealth is not abundant, much lumber must be imported. In southern Australia many species of trees common to the middle latitudes may be grown, and since scientific forestry methods are now being employed, we may expect a larger domestic production in the future. Native species, largely the many varieties of eucalyptus, grow in the coastal sections of the east and southwest; hardwoods grow in the south and the west and in Queensland and Tasmania, and pine occurs in Queensland and southern Tasmania, the Tasmanian species being used considerably.

While the eucalyptus has little value as lumber, it yields a commercial oil used in drugs and in the flotation process for treating ores. Consequently it is important for Australia. The blackwood of Victoria and Tasmania and the karra and jarrah woods of Australia—the latter said to be the hardest wood known—are used for interior work, cabinet woods, and beams, and are exported for use as railroad ties and paving blocks. Wattles, which are fairly abundant, have tannic acid in their bark.

Fisheries. The waters both of Australia, especially along the south coast, and of New Zealand have abundant but little used

supplies of food fish. Some large fish are also found in the inland waters. The national government maintains a scouting vessel to discover new fishing grounds. At present, considerable amounts of canned fish are imported.

The pearling industry, conducted mainly by Japanese fishermen, is important along the north and northwest coasts. The pearl shell goes chiefly to London, where it is sold at auction.

Minerals. Australia claims to be rich in at least 54 different minerals. The importance of most of them lies in the future. Depopulated mining towns, however, attest the depletion of some of the major deposits, although in some places operations have been maintained through the merging of companies and the working of low-grade ores and tailings by newer processes.

Gold mining furnishes the most romantic aspect of Australia's economic history. Industrialism and a democratic spirit date from the days of the gold camps. The gold rush of the fifties drew radicals from Europe because of the political disturbances of 1848, and the needs of the gold camps for food provided an early basis for agriculture. When the mines were worked out, many of the miners entered either agriculture or manufacturing. The discoveries in the fifties were at Bathurst, Ballarat, and Bendigo (Fig. 229), the business of these fields developing the port of Melbourne. In the nineties another field was discovered around Coolgardie and Kalgoorlie in western Australia, the latter being one of the greatest gold camps ever known. At Coolgardie one field a mile square returned half a billion dollars in gold in 25 years. Since these places are in the desert, it was necessary to pipe water for a distance of 250 miles.

Another important group of minerals is silver, lead, and zinc, which are combined in the ores. They are mined chiefly at Broken Hill (Fig. 229), which, at the height of its activity, was probably the greatest mining camp that ever existed. The ores, discovered in 1882, have been among the richest in the world in silver, their profitableness being shown by the following facts.

The original Broken Hill Mining Company issued a small amount of stock at £110 per share. A year later each share sold for £30,000. Six years later, one share, with its bonuses and dividends, was worth £1,250,000. A great deal of the ore was found near the surface in a low range of hills about two miles long and thus could be removed in an open cut. This district is at present an important producer of zinc. Ores from here are taken to Port Pirie to be smelted. A part of the zinc concentrate moves on to Ricdon, a suburb of Hobart, where the world's largest electrolytic zinc plant is located.

Australia is the leading coal producer of the Southern Hemisphere and is estimated to have two per cent of the world's reserves. Coal, said to occur in all of the states, in mined extensively in only a few places. The leading field and the only one that has been well explored is between Sydney and Newcastle and extends from the coast inland to a distance of one hundred miles, covering in total an area of about 16,000 square miles. The seams also extend under the harbor at Sydney. There are seven seams, the top one nearly 3,000 feet underground. It is estimated that there are about one billion tons above the 4,000-foot level. This field supplies bunkering coal to ships and exports coal to New Zealand, the Philippines, Hawaii, Chile, and the United States, to the latter chiefly as a return cargo. Enormous supplies are believed to exist in a field of about 12,000 square miles near Brisbane in southeastern Queensland. At Wonthaggi, near Melbourne, there are immense quantities of lignite, which are being turned into electricity in a large plant at Morwell, the fuel being ground to dust, after which it is blown into the furnaces. These deposits are so located that it has been estimated that the lignite can be supplied to the generating station at a cost so low as to be without precedent. There is water power in the Latrobe River, which adjoins the coal field. By the use of these energy resources, Melbourne hopes to regain the prestige which was lost to Sydney with the decline of gold mining in the hinterland of

Melbourne and the rise of coal mining near Sydney. The eastern coast of Tasmania has coal, but the lack of demand prevents exploitation.

Although iron ore occurs widely, it has been little used until recently. Development really started with the building of an iron and steel mill at Newcastle in 1915. Iron ore was obtained from large deposits at Iron Knob in South Australia, and limestone from New South Wales and Tasmania. Tasmania, Western Australia, the Northern Territory, and Queensland all have deposits of iron ore. Those of Western Australia are rich but inaccessible, while the ore from Queensland has been used mainly as a fluxing agent in the smelting of gold and copper ores.

Water power. Australia has an estimated potential water power of 600,000 horsepower, Tasmania of 700,000; 7 per cent of that of the former and 12 per cent of the latter have been developed. Almost all of Tasmania is mountainous, and there is a large lake in the center whose level has been raised 40 feet by the construction of two dams. The energy generated here is transported to Hobart, which, as a result, has developed manufacturing. There are also other lakes and falls for hydroelectric purposes.

On the mainland, Victoria and New South Wales may develop hydroelectric power in connection with irrigation projects. A hydroelectric irrigation plant would make Albury, in the center of the wool and wheat regions, an important industrial center. Queensland also has potential energy at Barron Falls, where there is a drop of 830 feet in 100 yards, 19 miles from Cairns, the sugar port.

Pastoral industries. The types of agricultural activities in Australia are a reflection of the climate, the long distance to market, and the sparse population. Aridity tends to make grazing important. The distance to markets limits profitable production to such commodities as have considerable value relative to their bulk and therefore can stand high freight bills. From any port in Australia the voyage to London requires 5 weeks by the fastest

mail boat. Sparsity of population, with the consequent lack of labor and home markets, results in the production of commodities that can be exported and that can be produced with a minimum of labor.

The leading animal industry is the grazing of sheep, and for decades Australia has led the world in the production of wool, both in quantity and quality. The high quality is partially natural and partially due to the care exercised in shearing and in preparing the fleeces for market. The industry has had an interesting development. Merino sheep were introduced in 1797. Until the discovery of refrigeration about 1880, mutton was not important, and even now wool production is more important. Since refrigeration has made possible exporting of meat, a dual-purpose animal has been developed by crossing the merino with mutton breeds. This cross also produces especially good market lambs. At present about 70 per cent of the Australian sheep are merinos, and the remainder are crossbreeds. The dry climate compels more attention to wool, because more moist conditions are necessary to produce a good quality of mutton. The proportions tend to vary with the relative prices of wool and mutton. Three types of merinos have been developed for different sections of the country. The climate of the Australian mainland is a little too warm for good wool sheep, and the quality tends to deteriorate after a few years. Consequently, cooler Tasmania makes an important business of supplying breeding stock to the mainland.

Sheep growing was started by squatters (in Australia the word "squatter" is synonymous with "millionaire") who settled on Crown lands, without a legal right to do so; their position was later recognized through leaseholds. Other lands were sold outright by the Crown. Today, much land is leased under long terms by the states to ranchers. Only about seven per cent of all the land in the country is privately owned. One leasehold in Western Australia, where 25 to 50 acres are needed to pasture one sheep, is said to cover 1 million acres. Many Australian

ranches contain more than 100,000 acres, with 25,000 or more head of sheep. There are almost a score of ranches with more than 100,000 head.

The chief sheep-growing districts are the inner plateaus of the semiarid western slopes of the highlands in New South Wales, Victoria, and Queensland. New South Wales has about 45 per cent of the total number, and the other two combined have about 40 per cent. Cattle grazing is also carried on in these districts.

For many years after 1891, sheep growing declined, and it is only recently that the number of sheep raised again reached its former figure of about 106 million head.

Drought was one reason for the decline. In 1902, 20 million head died; 15 million more died in 1914-15, and an additional 10 million in 1919. A second factor is the movement to break up the large estates. All of the states have the legal right to acquire portions of large holdings through the right of eminent domain for the purpose of selling land to smaller holders. All states have acquired considerable land in this manner. In spite of such efforts, the relative importance of pastoral industries has increased recently. A third influence is the tendency toward industrialization and the resulting population growth in the cities, which makes it necessary to grow more food products on the land. There is, however, much other land that might be pastured profitably if higher prices for wool prevailed.

Rabbits are a by-product of sheep raising. Someone took a few to Australia at one time, and since no natural enemies are there to kill them off, they have almost overrun the sheep districts. It is said that seven rabbits will eat as much grass as one sheep. Sheepmen pay men to catch the rabbits and give them the carcasses in addition, and millions of dollars have been spent in building rabbit-proof fences. Nothing, however, seems to decrease the numbers. Since the rabbits cannot be exterminated, the country has made a commercial product of them, exporting the meat and skins.

Australia has about 12 per cent as many cattle as sheep. Both

beef and dairy products are produced. The beef industry is principally in central Queensland, the dairy industry near the centers of population in the southeast and along the east coast. Cattle thrive the year round in the open, grasses furnishing food at all seasons. Large amounts of beef and dairy products are consumed in Australia, and there are surpluses for export. American and British meat-packing firms have established plants. Numerous municipal packing plants are operated; the best plant in Sydney is state owned.

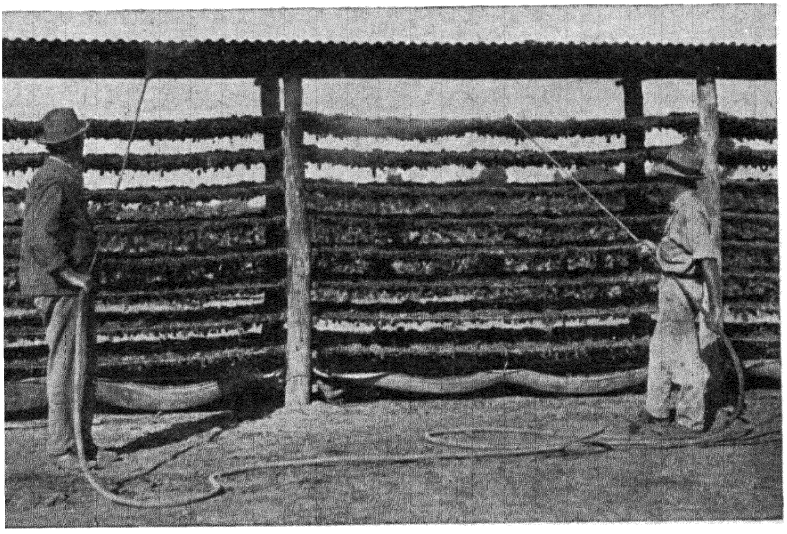
Crops. Though Australia grows many crops, dryness and small domestic markets tend to limit many of them. Wheat occupies as much acreage as all the others combined. South Australia has a third of the cultivated acreage, New South Wales a fourth, Victoria a fifth, and Western Australia a sixth.

The main wheat district is a narrow belt in the southeast on the western slope of the highlands, thence westward along the coast to the western side of the Eyre Peninsula. There is a minor area along the southwest coast. About 40 per cent of the output is from places with the Mediterranean climate. The yield, because of light rainfall, is low. Large-scale methods prevail because of the low yield and the extensive acreages of cheap land available. Automotive equipment is not used much, because of the high initial cost and the high price of gasoline. The open winters make horsepower cheaper.

Oats and hay are other important crops. Hay is usually only wheat or other cereals cut green. Poor wheat crops are often used in this manner. These crops are grown in the same general region as wheat, but in cooler locations. Hay does not receive much care because it is needed only in emergencies. Barley for brewing purposes and corn for green fodder in the dairy industry are grown in the southeast. Were there sufficient demand, much larger quantities of corn might be grown. Sugar cane, which is important to the fruit-preserving industry, is grown in Queensland and New South Wales. A sugar-beet industry is developing under irrigation in Gippsland in Victoria. Cane sugar is refined

in Sydney and Melbourne. The national government buys and refines the crop and controls its sale. Potatoes and onions are grown in large enough quantities to enable export to New Zealand and other near-by places. Experiments are now being conducted with cotton and tobacco. Such tropical crops as coffee and bananas grow in the north.

Fruit production, largely under irrigation, is an important and expanding industry. The climate is excellent, and the reversal



Commissioner for Australia in the United States.

Fig. 230. Fruit on drying racks, Mildura, Victoria.

of the seasons makes it possible to supply northern markets during their winter season. Apples are most important, leading in both Tasmania and Victoria; citrus fruits are the principal crop in New South Wales. Western Australia grows all kinds of middle-latitude tree fruits, and Queensland can grow both middle-latitude and tropical types. South Australia is first in the production of grapes and makes good wines, some being exported. Dried fruits, raisins, and currants are also important in the south. Mildura, in the irrigated part of Victoria, is the principal raisin center. Jam is made mainly in Tasmania, where the cool climate

is good for small fruits and berries. Large quantities of preserved products are sent to Great Britain.

Irrigation. Irrigation is important to the expansion of agriculture. The national and the state governments are jointly or severally bearing the expense of several projects. One of the largest is the Murray River scheme, which plans a dam just below where the Mitta Mitta River joins the Murray. It will cost $30,000,000 and will irrigate 12,000,000 acres. Most of the Murray also will be made navigable. In Victoria, the Goulborn Valley project is the chief among a score of others. It will irrigate 867,000 acres. New South Wales has eight projects, the chief one being the Murrumbidgee scheme, which will irrigate 200,000 acres. In the interior, where evaporation is great, underground cisterns are sometimes necessary for local irrigation purposes. Broken Hill, for example, receives only 9½ inches of rainfall annually, while it has an evaporation rate of 85 inches.

Manufacturing. The influence of mining on manufacturing has already been described. The gradual settlement of the country and the development of agriculture also caused an increase in manufacturing, because supplies of some raw products could be manufactured for home use and some had to be processed before they could be exported. But during the past quarter century forces have operated to increase greatly the relative importance of manufacturing. During the World War the isolation of Australia, the decrease in ocean tonnage, and the high ocean rates and insurance charges all made importation more costly. As a result home industries were stimulated. After the War, financial problems and the difficulty of finding employment for returning soldiers furthered the movement. More recently, the world-wide depression and the serious financial problems of the national and state governments have had the same effect. The expansion of manufactures has been accomplished since the War by the aid of protection to home industries. The expressed purpose of the tariff bill of 1920 was to force foreigners to build factories within the country. Outsiders, however, are afraid of labor conditions

there. Labor unions have a strong influence politically, and though they use the strike often, they rarely invoke violence. Labor costs are high, but in some cases these are offset by the proximity of raw materials.

Manufacturing clusters near the seaports. Attempts are being made, with some success, to develop inland locations. The leading industry is iron and steel production, chiefly at Newcastle and Lithgow. Affiliated industries are growing, especially at Newcastle. The products include railroad wire, galvanized iron, mining machinery, tool steel, and agricultural machinery. Melbourne has a factory making the last-named product and is an important city for other manufactures. The woolen industry ranks next to iron and steel; it is encouraged by the national government, and some mills are even government owned.

Other products are rubber tires, confectionery (Hobart has a chocolate factory), chemicals, tobacco products, flour, jam and jelly, soap, paper and containers, matches, clothing, cement, electrical equipment, and many others. This list indicates the diversity of the more necessary commodities that are required in a young country with a high per capita purchasing power.

Transportation. The independent development of the various Australian states has caused differences in their railway gauges. Adelaide and Melbourne are the only important cities that are connected by a common gauge. In going from Brisbane to Perth, six transfers are necessary. The prevailing widths seem to be 5 feet 3 inches and 3 feet 6 inches, the latter being used probably because of cheapness. There is also considerable mileage with the standard gauge of 4 feet $8\frac{1}{2}$ inches. After an investment has once been made in any given type of railway plant, obviously it is difficult to change. The lack of a common gauge has prevented as complete union among the states as otherwise might have been possible and is a great obstacle to trade and to travel. A commission has recently recommended a uniform gauge—a proposal that has been accepted in principle by all of the states.

Almost the entire mileage is government owned, each state owning its own lines. The national government owns a few lines, the principal one being the Transcontinental Railway, which was built to prevent the political isolation of the west.

The rivers of Australia are useful chiefly for irrigation, although some of the coastal streams are navigable for a distance of 50 miles, and the Murray can be navigated for about 1,500 miles in good seasons with paddle-wheel boats. The Murray and the Snowy Rivers flow throughout the year because they have their sources in snowfields. The others become a series of unconnected ponds at the low-water stage.

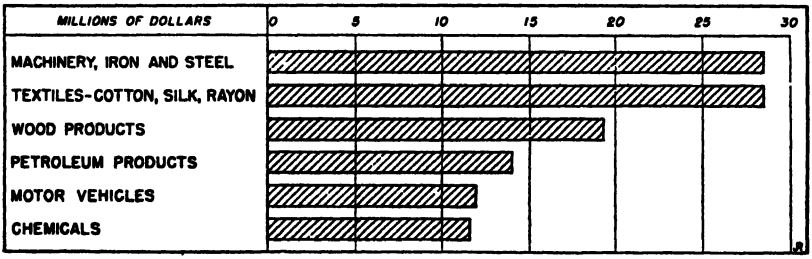


Fig. 231. Principal imports of Australia in 1935.

Foreign commerce. Animal products normally make up about 60 per cent of the total exports of Australia, which contributes about 40 per cent of the wool exports of the world and 20 per cent of the exports of butter (p. 484). Exports of butter have increased greatly since the adoption of Empire preference. Butter is transported to England for a cost of only one cent a pound. Exports are greater than imports. The total foreign commerce is about half as valuable as that of Canada. The mother country now buys slightly more than half of the exports and supplies almost that proportion of the imports. Of late, Japan has taken 12 per cent of the exports, chiefly wool, and has sent 7 per cent of the imports, while the United States has contributed 16 per cent of the imports. Empire preference may increase the proportion of the trade with the mother country and other British territory.

Sydney is the leading seaport of Australia, followed by Melbourne. These two handle the bulk of the trade. Sydney is on a landlocked, rock-bottomed harbor which is one of the best in the world. The harbor is entered through a narrow passage protected on both sides by high shores on which merchant princes have built their mansions. The city seems to be thoroughly Americanized and is said to resemble San Francisco in appearance. The harbor at Hobart is almost the equal of that at Sydney. It has

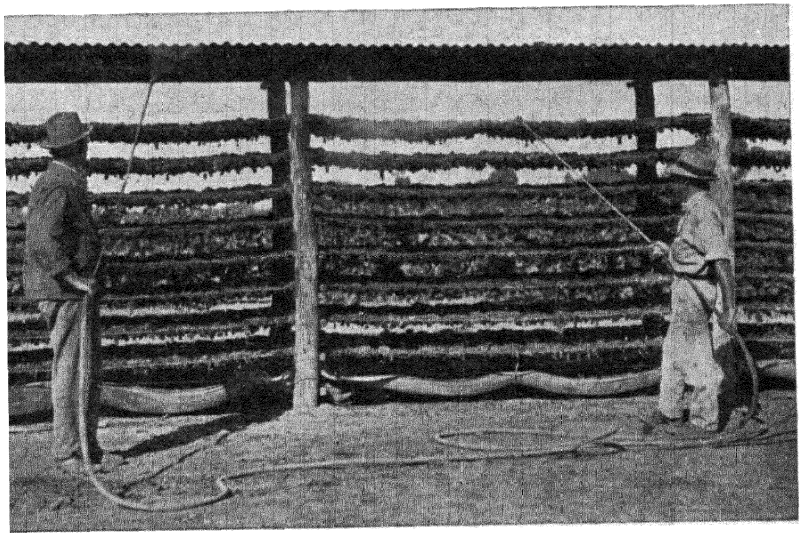


Fig. 232. View of Sydney Harbor.

a rock bottom and is 60 miles in length. Melbourne has a harbor that is larger than that of Sydney, but it has a mud bottom that requires constant dredging.

NEW ZEALAND

Geographic features. The Dominion of New Zealand, consisting of North Island and South Island and several smaller islands, contains 104,015 square miles of territory and about 1,600,000 people. The most significant feature of the Dominion is its

mountains. Extensively glaciated mountains with snow-capped peaks and a fiorded coast line in the south have made wonderful scenery in South Island, which, with the picturesque volcanic plateau of North Island and its geysers and health-giving waters, is developing a tourist traffic. There are several areas of coastal plain, the most important being the southeastern part of the two islands.

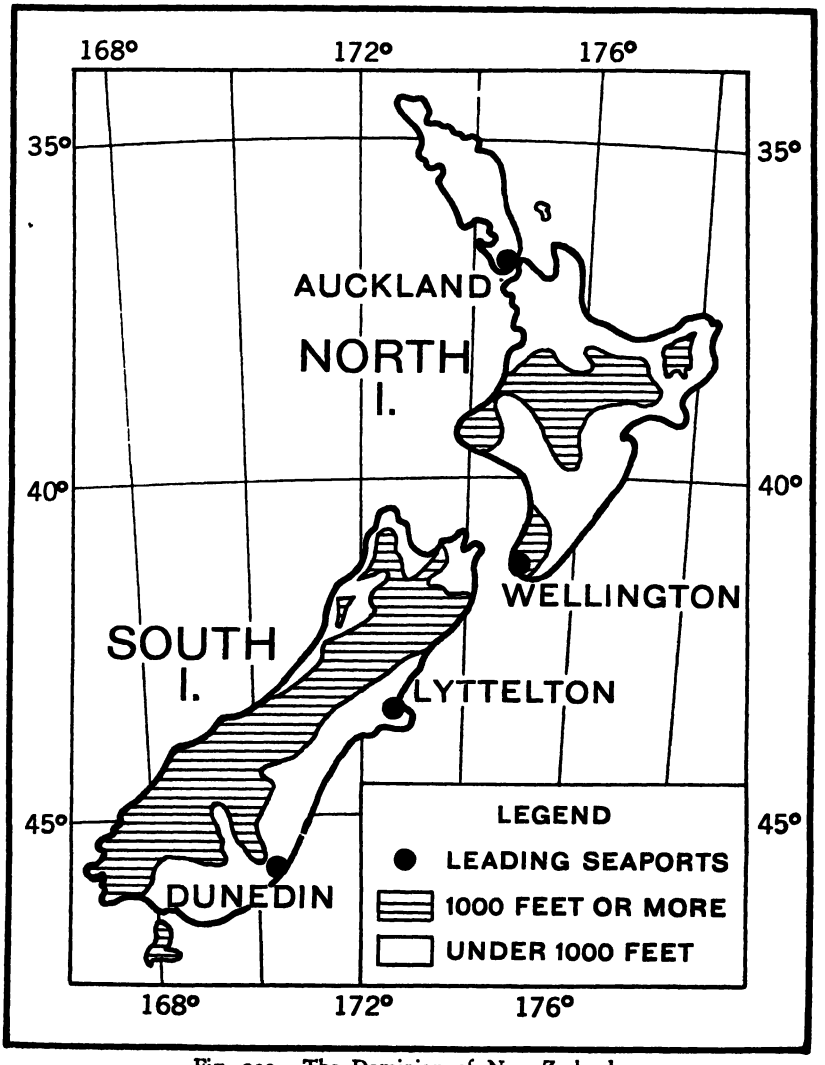


Fig. 233. The Dominion of New Zealand.

Climate. New Zealand lies in the belt of prevailing westerlies and has a climate similar to that of Great Britain, except for less severe winters. The eastern parts of the islands have a somewhat continental climate in places. In the south frost may be expected in all except the summer months; in the north the climate borders on that of the Mediterranean in some sections. Rainfall ranges from about 25 inches or more on the eastern plain of South Island to 70 inches or more in the higher parts of both islands. North Island has a relatively uniform distribution.

Pastoral industries. Pastoral industries are relatively more important in New Zealand than in Australia, but there is less concentration on wool. The richer pastures provide the abundant and regular supply of food necessary for the production of meats of good quality and for dairy products, both of which are important.

There are about 30 per cent as many sheep as in Australia, largely in the drier eastern parts of the islands. Different breeds have been developed for different districts. Before refrigeration was invented, the merino was the leading breed. Now wool sheep are kept in the hills and mutton breeds on the better pastures of the plains. Some of the latter are first grazed in the mountains and then fattened in the plains. Often they are turned into fields of turnips to fatten, or they may be driven across the mountains in summer to the richer feeding grounds on the moister west coast. The climate permits year-round grazing, which reduces costs in producing any type of animal product.

In the cattle industry, the production of beef originally was most important, but now dairying predominates, these islands being by nature especially suited to that industry.

Labor costs, though high, are offset by the widespread use of milking machines. Dairying is confined largely to the fertile lowland areas of the Aukland Peninsula and the Wellington Plain on North Island, districts which are too wet for successful sheep production. The difference in the location of the two industries should be noted: cattle are found where there are broad plains on

the windward sides of the highlands, while sheep are grown where there are extensive plains to the leeward of the mountain ranges.

Both cheese (p. 481) and butter (p. 484) are exported, and New Zealand ranks first among the nations for cheese and usually after Denmark for butter. Only Denmark and New Zealand and Australia are important exporters of butter, and, owing to Empire preference, New Zealand has gained, until the exports are almost equal to those of Denmark. Government inspectors watch the quality of dairy products carefully because it has been only through the development and maintenance of high quality that the country has been able to build and hold markets.

Kauri gum. An interesting export from New Zealand is kauri gum, which is used in the manufacture of varnish. It is a fossil gum that is dug from the soil where forests of the large kauri trees once stood or where they are now standing. The tree exudes a gum that hardens and falls from the trees. It may also be obtained by tapping the trees. The trees make excellent lumber and were at one time used as masts for ships.

Foreign commerce. The annual exports of New Zealand are usually a third as valuable as those of Australia. Other than coal and food, which are purchased from Australia, imports are largely the same products as those of Australia and usually are less than the exports. Recently about 85 per cent of the exports have gone to the mother country, and half of the imports have come from there. The United States supplies about 13 per cent of the imports, Australia 11 per cent, and Canada 7 per cent. Wellington and Lyttelton are the leading seaports.

New Zealand, because of newness, high productivity, and sparsity of population, and because economic activity is confined largely to the production of agricultural commodities for export, which makes it necessary to import manufactures, has the highest per-capita foreign trade of any country.

43

SOUTH AMERICA: THE WEST-COAST COUNTRIES

FINALLY, we return to the Western Hemisphere to a discussion of that rich but undeveloped area known as Latin America, in which the United States, because of vast investments of capital by its citizens and certain assumed political responsibilities, has a more direct interest than it has in most other foreign regions.

SOUTH AMERICA: THE CONTINENT

Retarded development. South America is historically old but economically young. Several factors have retarded economic development. Among these the physical handicaps of location, climate, and topography are fundamental. The major part and the best sections of the continent are south of the equator and away from the most frequented ocean routes; North America was more accessible to Europe, the great colonizing continent.

Tropical climates prevail over three fourths of the continent. They slow up the activities of white people, whose organizing ability and supervision of the natives seem to be necessary for the development of the tropics. The high uniform temperatures and high humidity are enervating, and the many insects and diseases that prevail sap the strength of even the natives. The principal diseases are malaria, hookworm, yellow fever, and dysentery. Negroes seem to be immune to some diseases, but the whites to none. Yellow fever has been conquered fairly well in Latin America, but the others have not.

Large areas of swamp, flooded regularly, and high mountains

and highlands with steep escarpments have made the provision of transportation facilities for many parts difficult and expensive. Settlers will not be attracted unless there are means for marketing, and private capital hesitates to build railways because of the scarcity of traffic. Air passenger service, however, has been highly developed locally, among the countries, and with other continents. This is particularly important to the Andean countries because the centers of population are in the highlands and are difficult to reach by other means of travel.

Certain cultural factors have also had a retarding influence. There have been many problems created by a small number of whites, often corrupt, ruling over large numbers of mestizos and Indians. Only in Argentina, Chile, and Uruguay, the most progressive countries, is there a preponderance of whites. The mestizos, who are difficult to rule and who are a main element in revolutions, range from an illiterate, ambitionless laboring class in the cities to those holding important positions in government service. The Indians, largely isolated and self-sufficient, are mostly in the Andean plateaus and the upper stretches of the many river valleys, in some cases having been pushed back as the whites settled the more accessible locations. Immigrants have been reluctant to go to those places with large numbers of mestizos, just as they have shunned our Southern States on account of the presence and competition of Negro workers.

Another cultural handicap is the lack of ambition and initiative in many of the upper-class Spaniards, and their disinclination to engage in manual labor or commercial pursuits. Rather, they turn to the professions or to politics, or live on the income from their estates.

Finally, immigrants have been kept away because most of the more desirable land is held in large estates, which the owners have not been willing or have not been forced by economic causes to break up into smaller holdings.

Geographic features. The major topographic features of South America are the Andes Mountains, the central plains, and the

eastern highlands, the latter consisting of the highlands of Brazil and those of Guiana.

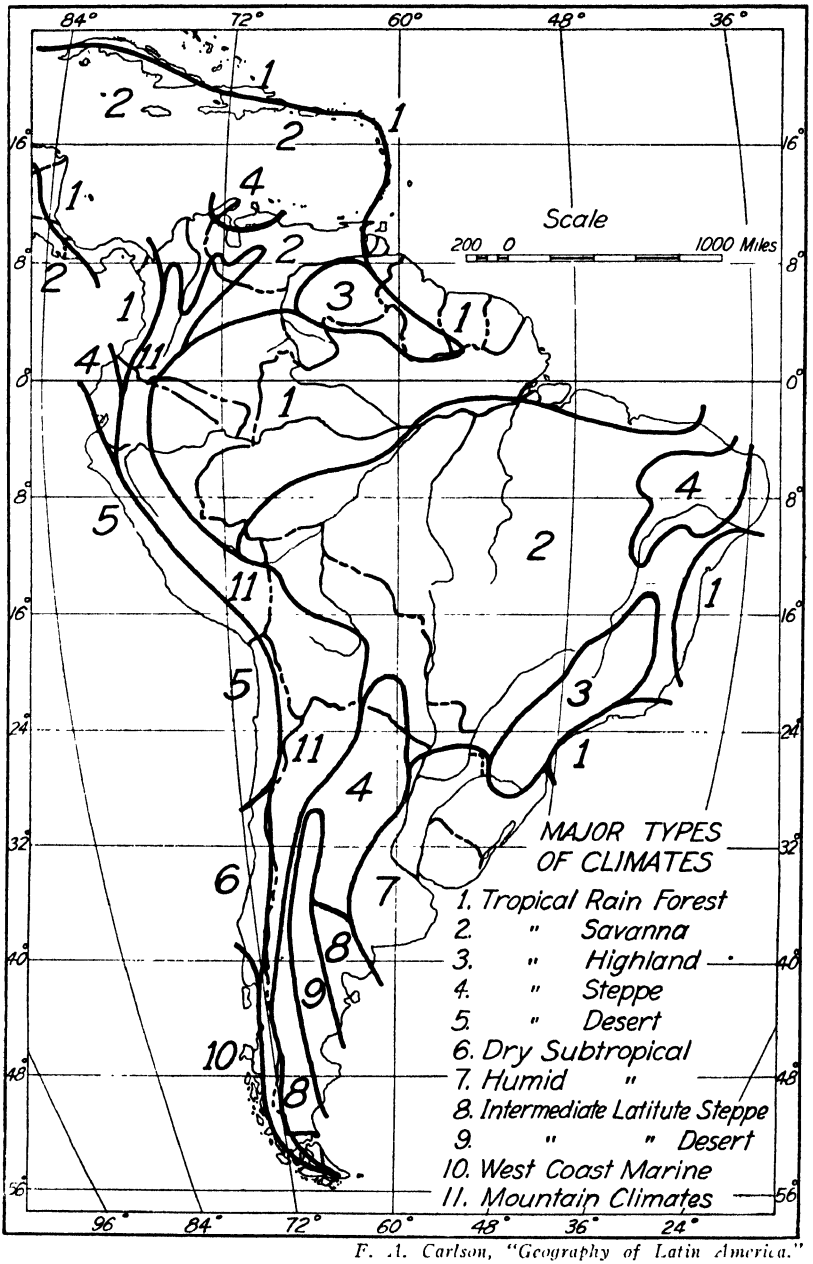
The Andes extend the length of the continent and run for a longer distance without important breaks than do any other mountains. Highest and broadest in their central part, where the ranges diverge to enclose the high plateau of Bolivia, the Andes gradually decline in elevation both north and south, spreading again north of Quito, fanlike, into three ranges with intervening river valleys, the innermost range extending across Venezuela along the coast. Since throughout their length the Andes are formed of series of parallel ranges joined by cross ranges, they contain many basins and tablelands, with numerous spurs extending at various angles from their sides.

Interfluvial plains of the three important river systems cover more than half of the continent, and portions once were sites of inland seas. They are not economically as important as other large plains of the world because of the tropical location of most parts.

The eastern highlands are parts of old crust blocks, the rocks being unfolded and in many places overlaid with sedimentary deposits. The Guiana highlands, because of nearness to the equatorial belt, are wetter, more heavily forested, and more inaccessible than the Brazilian highlands. The latter form a tilted plateau with the bold face toward the coast and therefore cause a serious transportation problem.

The highland areas of South America are of tremendous importance because of the large reserves of minerals and because their climate is cool enough to make habitation by white people possible.

Climate. Since essential climatic details are presented in the discussion of the several countries, only a few broad generalizations are in order here. There are extremes of rainfall, but an important feature of climate is the relative uniformity of temperature over large areas, there being only small seasonal ranges. Tropical location, tapering of the southern part of the continent, which



F. A. Carlson, "Geography of Latin America."

Fig. 234. Climates of South America. (Base map from the American Geographical Society. Climatic data after W. Köppen, R. Geiger, N. Bengtson, and others.)

permits the sea to have more influence, and the great height of the Andes all tend to prevent great variations. At least half of the land has 60 inches or more of rainfall annually, but there are considerable areas on both sides of the Andes and in northeastern Brazil that are desert or semiarid. The main desert areas are due to the obstruction of rain-bearing winds by the Andes. South of the latitude of Valparaiso the northwesterlies deposit their rainfall on the western side; thus they are drying winds as they go down over the eastern slopes. North of there the southeasterlies are obstructed in the same manner. A cold current adds to the aridity of northern Chile and Peru.

THE WEST-COAST COUNTRIES

Area and population. The four west-coast countries (Chile, Peru, Bolivia, Ecuador) together have roughly 20 per cent of both the area and the people of South America. Population density ranges from 6 per square mile in Bolivia and 7 in Ecuador to 13 in Peru and 16 in Chile.

Isolation. With the exception of Bolivia these countries front on the Pacific, and nearly all of the exports of Bolivia move through the seaports of Peru and Chile. This isolation by distance from important world markets long retarded the exploitation of the economic resources. The Panama Canal opened the markets of the United States to these countries, whereas those of Europe previously had been more accessible, and gave American manufacturers a competitive advantage in shipping to them. Since the canal toll for a freighter of 10,000 net tons is $12,000, the saving in time and on the funds tied up in cargoes must be balanced against the tolls to determine whether it is economical for a vessel to use the canal route.

Chile

Geographic features. Chile is similar in some important aspects to California. From east to west there are three regions: the Andes, the central valley with several transverse ranges of hills,

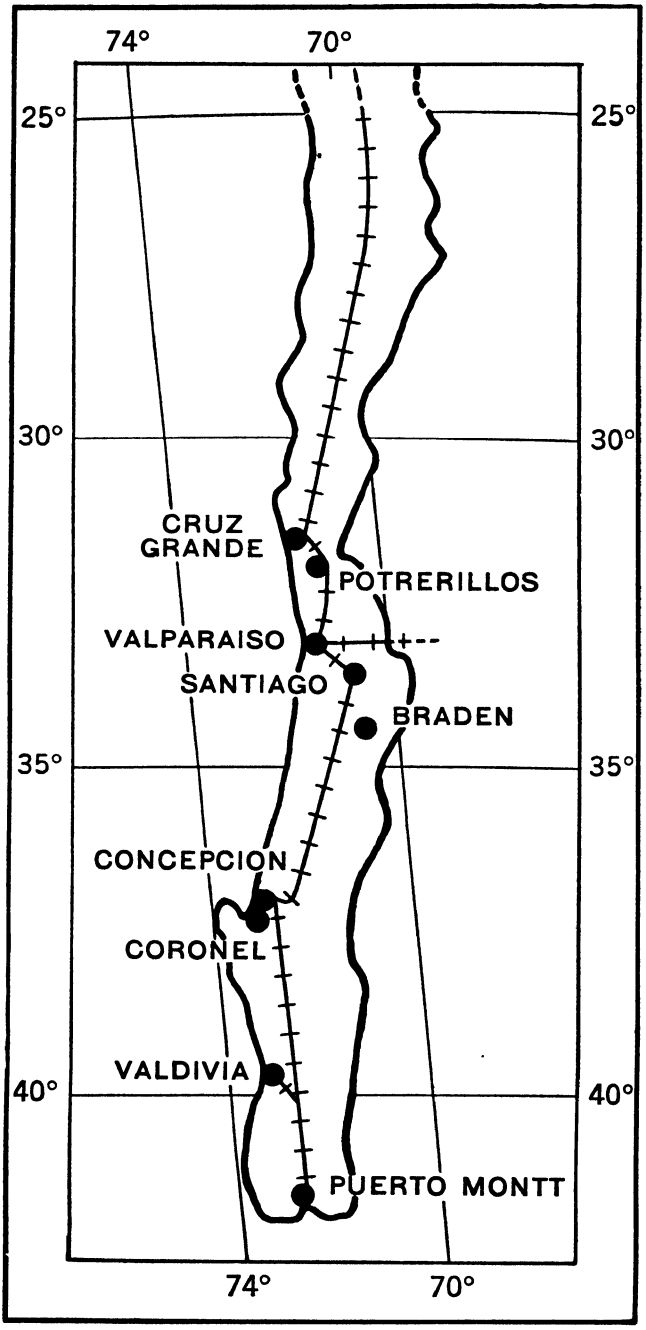


Fig. 235. Chile, between 25° south latitude and Puerto Montt, with principal cities and railroads.

and the coastal ranges with many small valleys and small bordering areas of plain. From north to south there are likewise three regions: the desert, the dry subtropical region which includes the coast and the central valley between 32° and 40°, and the forested region beyond 40° south latitude. The variety of topographic features and the great north-south distance result in a variety of resources and crops and hence provide the basis for interchange of

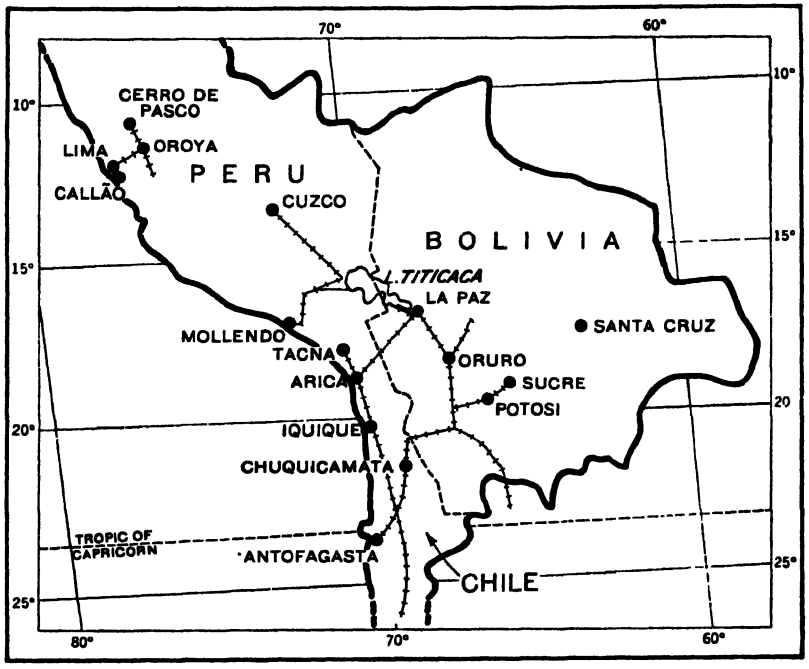


Fig. 236. The leading cities and railroads of southern Peru, Bolivia, and northern Chile.

commodities among the different natural regions, but the length creates a difficult transportation problem. The country is well balanced in regard to natural resources, and only the lack of a larger domestic market prevents their more intensive utilization.

Climate. A portion of north Chile is desert because of the Andes, which shut off the southeast trade winds, and the cold Humboldt current, the influence of which is discussed in connection with Peru. In the dry subtropical section the coastal plain

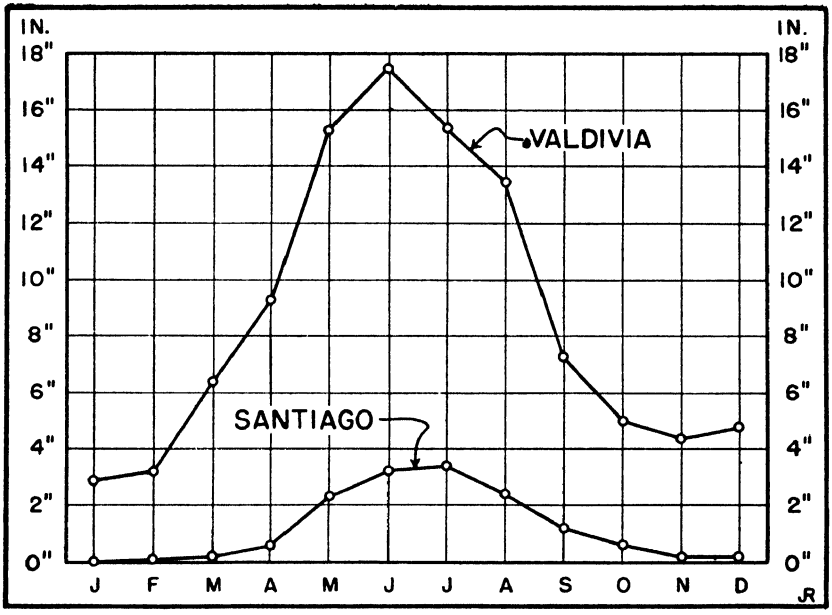


Fig. 237a. Monthly rainfall for Santiago and Valdivia.

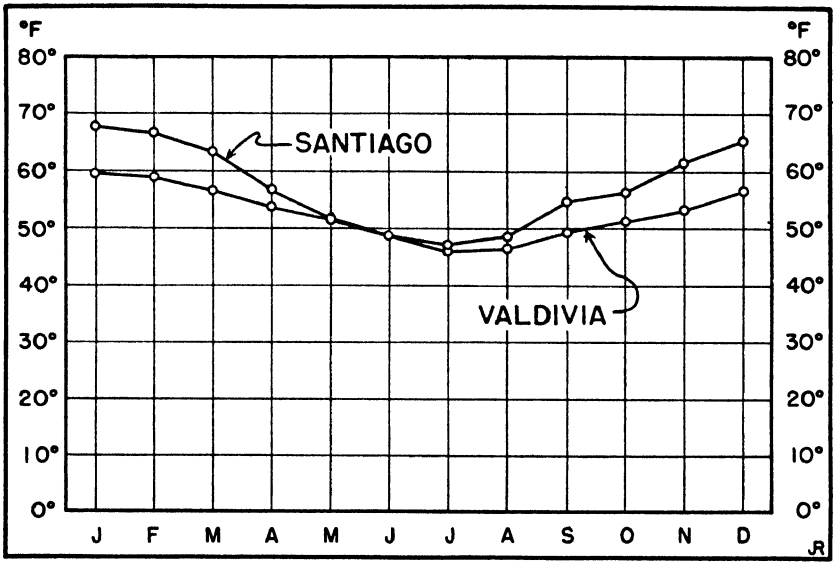


Fig. 237b. Mean monthly temperature for Santiago and Valdivia.

and coastal valleys receive more rainfall than the central valley, but there are irrigated crops in both sections. There are many snowstorms in the Andes, and occasionally one reaches the central valley. The forested region of the south is in the belt of westerlies and is cool and moist; in some parts the rainfall there is excessive.

Forests. About 3 per cent of Chile is forested with several species of good lumber trees, pine and beech predominating; the pine compares favorably in size with the large trees of our Pacific Northwest. In spite of these resources, lumber is imported from the United States because capital thus far has found more profitable employment in industries other than lumbering. The gradual extension of railways may in time overcome this difficulty.

Minerals. The leading mineral section is the desert central valley between Santiago and the border of Peru, in the northern half of which are nitrate fields that also provide salt and borax; in the southern half there are ores of copper, iron, gold, silver, and small quantities of several others. Recent monetary legislation in the United States and the encouragement that the Chilean government gave to placer mining as a means of combating unemployment during the early thirties have caused a marked increase in the output of gold and silver. There are deposits of low-grade coal estimated at 2 billion tons near the coast at Coronel, which is a fueling station for ships, and it is thought that there are also reserves of minerals in the southern end of the country.

Chile produces almost the entire world supply of mineral nitrate, but for several years artificial nitrate has offered such serious competition that there has been a marked decline in the industry. In 1913 Chile contributed almost 60 per cent of the nitrogen for fertilizer and other purposes; now the quantity is less than 25 per cent. The world-wide depression of the early thirties further injured the industry so much that the government had to take a part in its drastic reorganization. The national government is especially interested because it has at times obtained as much as 60 per cent of its revenues from the export tax which is levied on the

product. Most of the nitrate land is owned by the government, and the nitrate is mined under concessions obtained at auctions. Considerable foreign capital has been invested in the industry.

Caliche is a poorly indurated surface rock impregnated with nitrate salts which are readily soluble in water and therefore occur as solids only under desert conditions. The rock is mined by open-cut methods, after which it is taken by mule or by truck to the *oficina,* where the salts are dissolved and then precipitated by evaporation. The *oficinas* operate with coal from Australia and petroleum from Peru, Ecuador, and California. Water is piped from the Andes, the pipe lines usually following the railway routes. Iodine and salt are by-products of the industry. Chile produces 90 per cent of the world's iodine, the production being controlled to suit the demand. The leading center of nitrate mining is Antofagasta.

Chile ranks next to the United States as a producer of copper, supplying about 20 per cent of the world output, and the reserves of ore are among the world's largest. Copper ores occur at several points, but the most important deposits, American owned, are at Braden near Santiago, at Potrerillos, and at Chuquicamata. The cost of production is among the lowest in the world because of the ease of mining and nearness to the sea and because the reserves are extensive enough to justify heavy investments in modern, large-scale equipment. Antofagasta is the leading port for exports of copper and copper concentrates.

Near the port of Cruz Grande are reserves of iron ore estimated as high as a billion tons, owned by a steel company in the United States. Some of the ore is smelted in Chile, but most of the production is sent to Atlantic coast smelters of the United States.

Water power. Considerable hydroelectric energy has been developed from rapid streams which flow from the snow-capped Andes across the central valley, and much more could be developed were there sufficient demand. This is important in view of the poor quality of the coal. Electricity is used in manufacturing and

is important in operating the railways, power for operating some of them being obtained from the Maipo River, where sufficient power to electrify the entire system might be developed.

Agriculture. About 37 per cent of the land area is classed as agricultural land, but only one tenth of this is now in tilled crops. Pasture lands occupy 20 per cent of the country. The central valley to the south of Santiago is the leading agricultural district, this being one of the three most densely populated parts of South America; the other two are the pampas of Argentina in the vicinity of Buenos Aires and Rosario and the eastern part of Brazil between Santos and Cape St. Roque. There is also a considerable acreage in crops in the northern part of the cool forest region, and the desert has some irrigated valleys crossing it. The farm lands are chiefly in large estates, 5,000 holders controlling 90 per cent.

Crops. The outstanding crops are wheat, grapes, and citrus and middle-latitude fruits. Wheat occupies 50 per cent of the land in crops. The industry was started to supply flour to the miners at the time of the California gold rush. About $135,000,000 are invested in the grape and wine industries. A good quality of wine is made, some of which is exported to Belgium and Germany. The quality is watched carefully by inspectors at the ports. Table grapes, plums, pears, and peaches are shipped to the United States during our winter months. Legumes, potatoes, oats, barley, and corn are other crops.

Animal industries. Sheep comprise almost two thirds of the total number of animals, and cattle one fifth. Sheep are grazed principally in the cool, moist southern tip of South America, which will be discussed in the next chapter. Cattle are equally divided between the central valley and the cool south. Dairying is increasing, and the production of butter and cheese is of major importance.

Manufacturing. Manufacturing is of considerable importance and is growing under the encouragement of the government. The type of people, isolation, and variety of raw materials are favoring influences. The leading manufactures are food products,

leather goods, wearing apparel, and gas and electricity. Chemicals, textiles, tobacco, beverages, and paper are also important.

Transportation. Isolation, shape, and variety of products result in a considerable mileage of railways. There are many short lines running inland from the ports, and the inner ends of these have been interconnected until there is a longitudinal line that extends nearly all the way from Tacna in Peru to Puerto Montt. Several gauges, however, make the lines less useful than they might

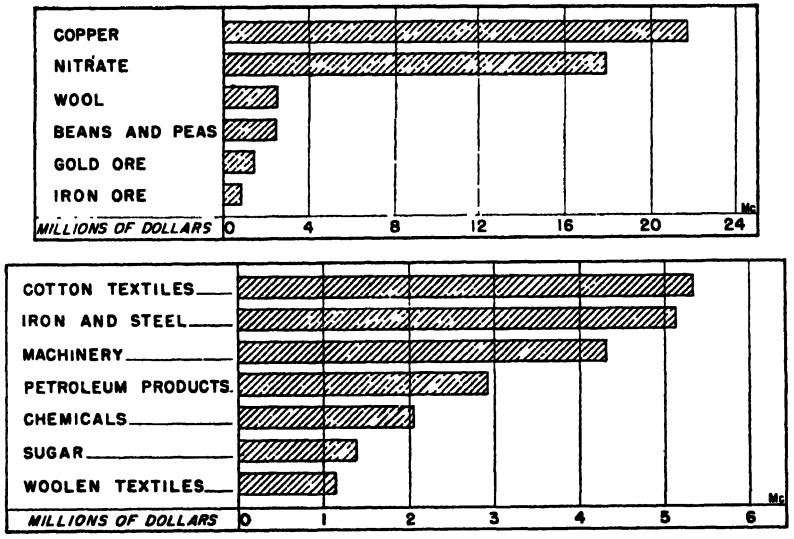


Fig. 238. Principal items in the foreign commerce of Chile in 1935; exports above, imports below.

be. Antofagasta is connected by rail with Bolivia, and Santiago with Buenos Aires. Other lines from Argentina are discussed in the next chapter. Chile has planned two other lines to Argentina, one in the south, the other in the north. In spite of the mileage of railways, the bulk of the domestic trade is intercoastal.

Foreign commerce. Minerals stand out among the exports of Chile, manufactured goods among the imports (Fig. 238). Of late exports have been about double imports. A quarter of the trade has recently been with the United States, 18 per cent with the United Kingdom, and 7 per cent with the German Reich, imports

and exports being about equally divided in each case. Our principal imports from Chile are gold and silver, copper ingots, and nitrate; our leading exports are machinery, iron and steel, crude petroleum, and cotton textiles.

Valparaiso, which serves Santiago, and Antofagasta, Iquique, and Arica are the leading seaports. The Chilean coast is a leading center for sailing vessels. Valparaiso has a good harbor, though

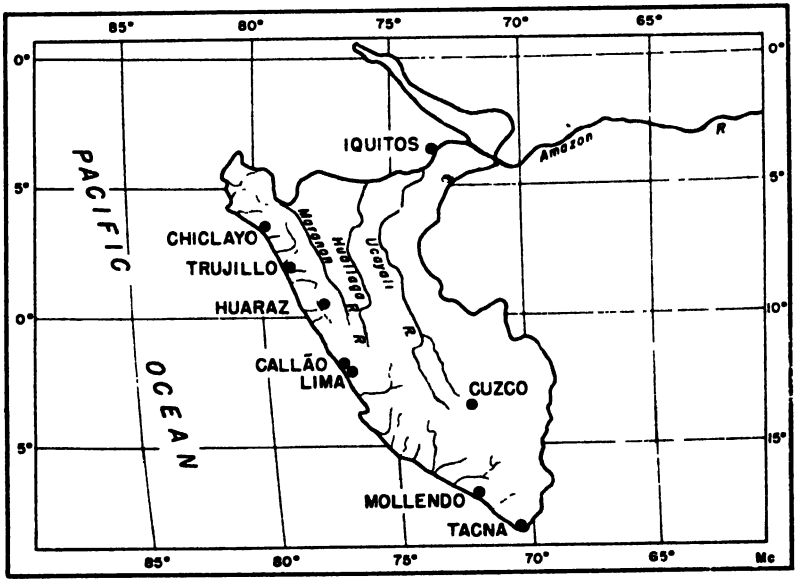


Fig. 239. Principal rivers and cities and the important transverse rivers of Peru.

it needs improvement, and there are many good but unused harbors along the fiorded southern coast.

Peru

Geographic features. Peru consists of a narrow, desert coastal plain, highlands, and an extensive eastern lowland. The desert is an extension of the one of northern Chile, caused, as was previously stated, by the Andes and a cold ocean current. The air in passing over the current becomes cooled, and, since the coastal land is warm, the air masses are not chilled sufficiently to cause

precipitation until they reach the higher mountain slopes, in some places more than 100 miles inland.

At times this current seems to shift its location, permitting parts of the desert to receive rainfall. Rains occur along the coast of Peru at irregular intervals. A southward-flowing current occasionally moves along the coast about Christmas time. Some people think this current is caused by the heavy rains in Ecuador at this season and that at times its force is enough to divert the cold current, causing a rise in temperature, and rain.

The Humboldt current contains many fish, which are the food of countless birds which live principally on the coastal islands of Peru. The excrements and remains of these birds form guano, an important fertilizer in the agriculture of Peru. It was formerly exported in large quantities.

Minerals. Petroleum of high quality is the most important mineral product of Peru. There are several fields, mostly in the northwest part of the country. Because of the scarcity of coal, petroleum fills an important need. It is used on the railways and in some of the manufacturing and mining industries, and for public utilities. Copper ranks next to petroleum, the chief center being in the Department of Junin, in which are located the Cerro de Pasco concessions. The plant of this company is one of the most complete in the world. Silver is produced as a by-product. Gold, chiefly from the Puno district, is third. The Minasragra district has the world's most important vanadium deposit, which is owned by a corporation in the United States. At Marcona is a large deposit of iron ore. Coal of poor quality occurs in several places, and guano is also important. Hydroelectric power has been developed and is used in the mining industry.

Agriculture. Agriculture is more varied and receives more attention in Peru than in any of the other countries of the northern Andes. There are fertile mountain basins and more than 50 transverse valleys with fertile alluvial soil; most of them require irrigation. Thousands of acres are now under irrigation and new facilities are being built, but there is perhaps not sufficient

water to irrigate all of the 50 million acres that otherwise might be farmed.

Crops. Cotton and sugar are the principal commercial crops. Cotton, the leading crop, is grown under irrigation in about 35 of the transverse valleys, chiefly in the middle coastal section, where exceptional conditions exist because of the uniform temperatures and the lack of rain, hail, and frost. The best quality is grown near Piura. The cotton lands are worth from 150 to 300 dollars or more per acre, depending on the price of cotton. Because of this and the expense of irrigation, much capital is required in growing the crop. Several varieties are grown, and the staple compares favorably with that of Egyptian cotton. The leading kind is Tanguis, which is hardy and grows to be about 6 feet tall. Two or three crops are harvested from a single planting. There is a small production of "Peruvian full rough" cotton, which is native to the country and which grows in various shades of color and is crinkly like wool. On this account it is used to mix with wool in manufacture. It grows on a small tree, which produces a good crop for 4 or 5 years before it must be replanted. The plant bears twice a year.

Sugar cane is the second crop in value. Peru is a low-cost producer, and a large part of the sugar is exported to other South American countries. Temperature and soil are ideal for the crop, and there is the further advantage of cheap guano fertilizer. Sugar cane is grown in several of the irrigated river valleys, largely along the northern half of the coast. Five hundred gallons of water are required to grow one pound of sugar. The leading area is the Chicaima Valley around Trujillo. The district around Chiclayo is second. Production is chiefly on 50 large estates—relics of the days of the Spanish conquerors—which contain about 120,000 acres. In the Chicaima Valley 4 or 5 estates employing modern methods control most of the acreage. As a rule 3 cuttings are obtained from a planting, but on the better soils 7 or 8 may be made. In Peru, the cane requires a year and half or longer to mature; but after a plantation once starts bearing, cutting extends

more or less throughout the year, owing to uniform climate. From 40 to 60 tons of cane are grown per acre. The government levies an export tax on sugar.

The local food crops are corn, wheat, potatoes, barley, and quinua (a native cereal), all grown in the highlands by very primitive methods, mainly northward from Lima, and rice, which is grown along the coast of the northwest. Corn, grown under irrigation in fertile mountain valleys, is a mainstay of the diet. Wheat is grown in the high mountain valleys, and its production is being encouraged. The highlands of Peru are probably the native home of the potato, which is important in the diet and is grown in many sizes and qualities. The chief center is around Huaraz. Barley is important at high altitudes, and quinua grows at a higher altitude than any of the others and under more adverse conditions. Rice is an important food crop and the acreage is increasing, but imports are necessary to meet the demand.

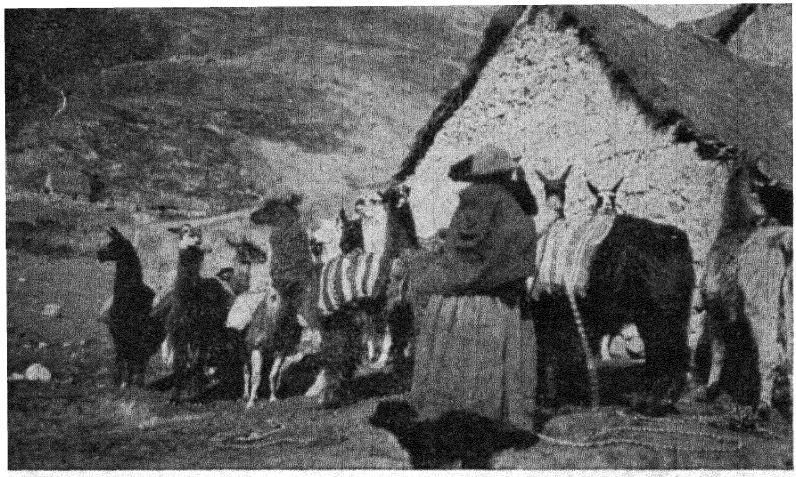
Other crops are coffee, which is grown in the central part of the country where colonization has recently taken place, and the coca shrub around Cuzco, the old Incan capital, which is located in a fertile basin and is yet an important center. Both silk culture along the coast and grape growing and cacao in the Perené district are promising industries.

The Indians on the high mountain slopes subsist by cultivating patches of barley, quinua, and potatoes and by tending small flocks of sheep, alpacas, and llamas.

Animal industries. Cattle, sheep, and goats, and several species of animals native to the Andes highlands are raised widely in these countries; hides, skins, and various kinds of wool are the main products that the natives have to exchange for imports that they need. Often other products that are exported are wrapped in the hides and skins. Hides, skins, and wool are durable and have considerable value in small bulk; therefore they are able to bear the high freight charges incident to sending them out of the country. The quality of the animals is poor, many of the herds belonging to the Indians, who take no interest in their improvement.

Cattle and sheep are kept in the largest numbers. Goats are found on the rougher and poorer lands, and nearly every cattle and sheep ranch has a herd of goats to utilize such lands.

Important to the Indians are several native animals, some of which have been domesticated, and none of which have ever been grown successfully elsewhere. The most important one is the *llama,* which is used largely for transportation. It is surefooted



Pan American Union.

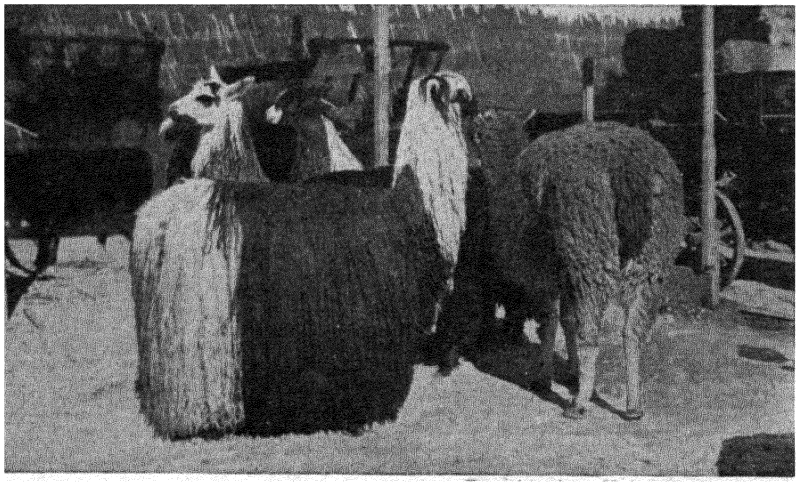
Fig. 240. Peru: llamas in the village of Pargora, high in the mountains.

and, like the camel, is able to go for several days without water. An animal may carry as much as 100 pounds, but the average load is about 40 pounds. The following quotation shows its place in the life of the natives:

> The llama is vital to the Indian; it clothes the Indian with its wool; it provides tools and utensils from its bones; it gives light from its fat, fuel from manure carefully gathered and dried, drum heads for feast days and leather straps for pack harness and saddle; and finally, after spending a life as a beast of burden, making the fortune of its master, or when it accidentally falls over a cliff and breaks a leg or its neck, it supplies meat for the underfed Indian. The wool is coarse and heavy and does not enter export trade, but the pelt provides the only bedding the Indian possesses.[1]

[1] Clarence F. Jones, "Agricultural Regions of South America," *Economic Geography,* 5:293.

The alpaca is raised for its wool, for it is too small for an efficient pack animal. There are alpacas of several different colors, and some produce a very long wool. The average annual production is about 6 pounds per animal, but usually they are sheared only in alternate years. The animals are raised almost entirely by Indians, in flocks of 50 to 2,000. Originally the animals of dif-



Pan American Union. F. E. Henley.

Fig. 241. Peru: long-haired alpacas.

ferent colors were kept in separate flocks, but for a long time they have not been produced scientifically. Alpaca wool has a permanent luster, even after being dyed.

The vicuna is a small wild animal adapted to extremely high elevations. It has a very fine and soft wool, from which the clothing of the Inca rulers was made. It produces less than a pound of wool per year. For a while the slaughter of this animal went on so rapidly that it was in danger of becoming extinct. The governments of both Peru and Bolivia now prohibit its slaughter and the exportation of the wool, and the number is increasing. Several large ranch owners are attempting to cross the vicuna with the alpaca to get a larger quantity of soft wool. The main difficulty is that white people cannot live at the altitude required by the animals, and it is difficult to get the Indians interested in the

improvement of the industry. Vicuna cloth has recently sold for $75 a yard in the United States.

Another animal of the high Andes, chiefly in Chile, is the small chinchilla, whose fur is so desirable for making coats that at one time it was almost exterminated.

Transportation. The railways of Peru are lateral lines that connect the mining centers of the mountains with the seaports, some owned privately and some by the government. Construction is expensive because the mountain passes are at extremely high ele-

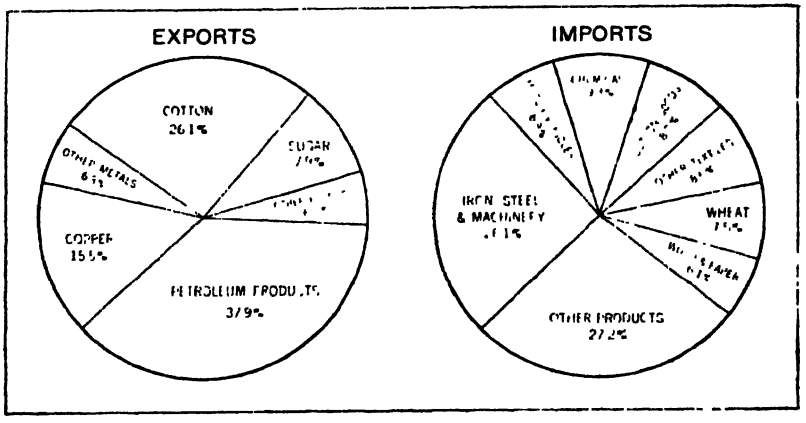


Fig. 242. Principal items in the foreign commerce of Peru in 1935

vations, the canyons are deep and narrow, and the slopes steep, necessitating steep grades. The Central Railway of Peru rises almost 16,000 feet in 106 miles and has 21 switchbacks, 65 tunnels, and 61 bridges. Plans have been formulated for connecting the west coast with the Amazon basin by rail. Already there is a railway and a paved highway to Oroya, the latter having been completed in 1935.

Foreign commerce. Natural advantages for growing several crops and location near many mining centers and centers for exchange with countries of different climatic conditions give Peru a varied and important foreign commerce. For several years exports have been nearly double the imports. The United States has recently taken a fifth of the exports and has supplied a third

of the imports, followed by the United Kingdom with 33 and 17 per cent, respectively, and the German Reich with 10 per cent of each. France, Argentina, Canada, and Chile are also important in the trade.

Callao, serving Lima, is the leading seaport. There are several smaller ones along the northern coast which serve the petroleum and sugar districts, and several along the southern part, Mollendo being the main one, which serve the mining districts of the highlands.

Bolivia

Geographic features. Bolivia consists of a high, dry, cold plateau in the southwest, and of wet tropical lowlands in the north and east, the latter partially the lowlands of the Amazon and Paraguay Rivers and partially the fertile valleys and lower slopes of the main streams between the spurs which extend at angles from the main ranges of the Andes.

Minerals. While Bolivia is of commercial importance chiefly for tin, in which it ranks next to the Malay Peninsula, there are deposits of nearly all the known metals. The reserves of some of these are much greater than those of tin. Second place is now held in the production of antimony, and the ores of copper, silver, and gold are both abundant and rich. Much of the mining is in the Cordillera Real Range. Oruro is the principal mining center, Potosi the leading center for tin and silver.

Tin ore for export must be concentrated. The process is similar to that for smelting iron ore. The importance of fuel is evident. There are local supplies of coal, but it is usually cheaper to import from Great Britain as a return cargo on ships hauling tin concentrate to that country. Hydroelectric power is used in some mines. Most of the important cities of the Andean countries have electricity and are probably more modern than is usually thought.

There may be important reserves of petroleum in the southeastern lowland; in the opinion of some people the recent war between Bolivia and Paraguay was fought over their possession. An Amer-

ican company has started to exploit the district south of Santa Cruz.

In addition to the scarcity and high cost of transportation and the lack of fuel, the lack of capital and the difficulty of obtaining suitable labor also retard mining in all of the Andean countries. Because of the high altitudes only those who are native to the region can do manual labor; the supply of native labor is scarce and the natives are not much inclined toward mining.

Agriculture. Since the production of local food crops and the tending of animals in Bolivia and the remaining countries of the Andes are similar to those industries in Peru, only the important money crops of the Andean countries will be discussed. Bolivia has great opportunities, particularly for subtropical crops, when the lowlands in the east are provided with good rail outlets.

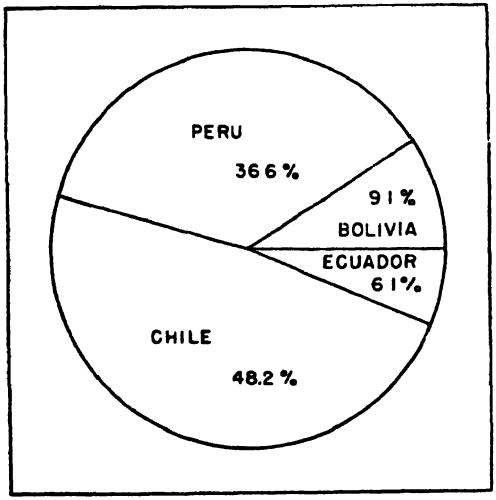


Fig. 243. Percentage of total volume of exports contributed by each West-Coast Country.

Coca. The leading money crop of Bolivia is coca leaves, from which cocaine is obtained. The coca plant is native to the northern Andes, growing in the hot lowlands and on the lower slopes of the mountains. It is more productive on the lowlands, but a better quality of leaf is obtained on the drier locations on the slopes. When the plants are cultivated, about 7,000 are set per acre, and they are grown in plots of a half acre or more. The leaves are harvested three times a year, each plant producing about 4 ounces at a picking. They are then dried and pressed into bales for marketing. As much as 500 pounds of dried leaves may be produced

on an acre. They retail for about 50 cents per pound, the marketing cost being high. Cocaine is extracted for export in the larger cities, and the coca leaves are also exported. The crop is grown chiefly in the Department of Yungas, where a superior quality is produced. Coca leaves are chewed by nearly all the highland Indians above 6 years of age to relieve hunger, cold, thirst, and fatigue. The practice has had a numbing mental effect. This same region has a small production of coffee, which the Bolivians claim has the best quality of any coffee.

Transportation. Bolivia is connected with Buenos Aires, Arica, Antofagasta, and Mollendo by rail; the last three are now the important outlets. Arica is the foremost import center. It is thought that the railway extending from the east coast of Brazil to Corumbá will soon be extended into Bolivia. Lake Titicaca is also an important link in transporting the products of Bolivia.

Foreign commerce. In 1935 metals comprised 94 per cent of the exports of Bolivia, tin alone accounting for 80 per cent. Silver contributed 7 per cent. The leading imports were textiles and clothing, iron and steel and mining machinery, sugar, flour, wheat, rice, and coal. More than four fifths of the exports went to the United Kingdom, and a fifth of the imports were from there. The United States supplied 30 per cent of the imports.

Ecuador

Geographic features. Topographically and climatically Ecuador is similar to Peru except for the northern part of the coastal plain, which is in the doldrums, and hence is warm and moist. This plain is the leading agricultural section of Ecuador and is as fertile as any area in South America.

Minerals. Petroleum, from deposits in the southwest, is the leading mineral product and serves the same purpose as in Peru. Gold occupies second place, and silver third. Rich silver ores occur at Pillzuhum, and there are large quantities of sulphur in the Chimborazo district and in the Galapagos Islands, which are

owned by Ecuador. Quayaquillite, a fossil resin used in explosives, is mined near the Daule River and there are ores of iron, copper, and lead and some coal.

Crops. Cacao is the leading money crop of Ecuador, and coffee is second. The cacao tree grows wild, and on plantations in the lowlands and river valleys and also on the lower slopes around the Gulf of Guayaquil, chiefly along the Guayas River system. At one time Ecuador led in the production of cacao, but now it usually ranks eighth. A disease of the tree, which now seems to



United Fruit Co.

Fig. 244. Cacao trees in bearing.

be under control, unscientific methods of production, and the policy of the government in taxing the exports of cacao, along with the uncertainty as to the future of this policy, account for the decline of the industry. Furthermore, the Gulf of Guinea region, Brazil, and the Caribbean region have more abundant labor as well as better commercial locations than Ecuador.

Coffee is grown on the mountain slopes in the south, where there is much land suited to it. Output has almost doubled since 1932.

Coffee production requires more labor and more equipment than does that of cacao.

Bananas, oranges, rice, sugar cane, and cotton all are increasing, and the former three are important exports. The output of bananas has increased fivefold since 1932, and that of oranges has doubled. These fruits are exported to Peru and to the nitrate district of Chile, and bananas to the west coast of the United States.

Ivory nuts. Ivory nuts, the source of vegetable ivory, from which most buttons are made, grow on the tagua palm, a small

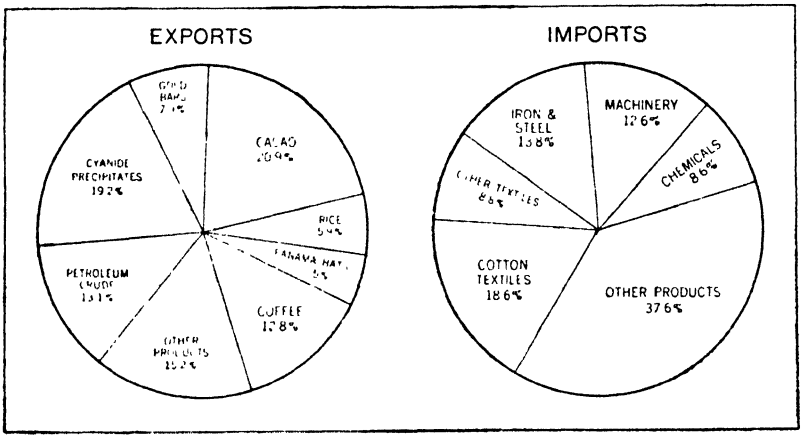


Fig. 245. Principal items in the foreign commerce of Ecuador in 1935.

tree of Ecuador and neighboring countries. The fruit, about the size of a man's head and resembling a huge chestnut bur, contains from 60 to 90 hard nuts, which may be polished and dyed. At the factory the nuts are dried and the shell removed, after which the nuts are sawed into thin pieces. Only the outer part is used, the kernel being useless.

Panama hats. Ecuador is famous for the manufacture of Panama hats, Jipijapa and Monte Cristo, the leading centers, producing the best in the world. These hats are made from the leaf of the toquilla palm, which is cut just before it opens and which must be kept moist when being worked. Owing to their nimble fingers, women and girls make the best hats, and five or six months

sometimes are required to complete a hat of exceptionally fine quality. Most of the hats sell for about 50 cents in our money, although the best ones may sell for as much as $100. Foreign competition has caused a high duty to be placed on the exporting of the straw, and there is a growing market competition from similar types of hats made in other countries.

Transportation. Ecuador experiences problems in transportation similar to those of Peru. The Guayaquil-Quito Railway has 3 tunnels and 70 bridges; along one section it crosses the Chauchan stream 26 times and its tributaries 13 times. There are some improved highways, and in the leading agricultural valleys the rivers have been dredged and are used locally.

Foreign commerce. The total foreign commerce of Ecuador, though not large, includes a wide variety of commodities. Exports normally are considerably greater than imports. Recently about 45 per cent of the exports have gone to the United States, and one third of the imports have been from there. The German Reich, the United Kingdom, and Japan each is about a fourth as important as the United States, but all export considerably more to Ecuador than they import from her.

Guayaquil is the leading seaport, serving Quito and the nearby agricultural plain. At one time it was one of the worst places known for yellow fever, but largely owing to the efforts of the Rockefeller Medical Foundation the disease has been stamped out. Guayaquil is now a modern, attractive city provided with up-to-date facilities in all lines.

44
THE EAST-COAST COUNTRIES

Area and population. The east-coast countries of South America—Argentina, Uruguay, Paraguay, and Brazil—combined are 50 per cent larger than the United States and have 70 per cent as many people. Taken collectively, Argentina, Uruguay, and Paraguay are equal in area and population to the four west-coast countries. Brazil contains almost half of the total area of the continent and more than half of the people. It has three times the area and four times the population of Argentina. Though Brazil is 10 per cent larger than the United States, it has only 37 per cent as many people. Population density ranges from 6 per square mile in Paraguay to 12 and 15 in Argentina and Brazil, respectively, and 28 in Uruguay.

The people of Argentina, a quarter of whom are recent immigrants, are largely Spanish and Italian. Most of the recent immigrants have been Italians. The majority of the people of Paraguay are Indians, since the country served as a refuge for the natives who were driven inland by the settlement of the whites. Brazil has a large white population, but there are many Negroes in the hot lowlands and Indian tribes scattered over much of the interior. Immigrants have been chiefly Italians, Portuguese, and Spanish, with small numbers of Germans, Russians, and Japanese.

The Plata River system. Within the four countries lies the great drainage basin of the Plata River system, half of which is in Argentina. All of the countries except Brazil depend to a large extent upon these rivers for transportation, Paraguay almost wholly. The development of the interior of Brazil will require their use.

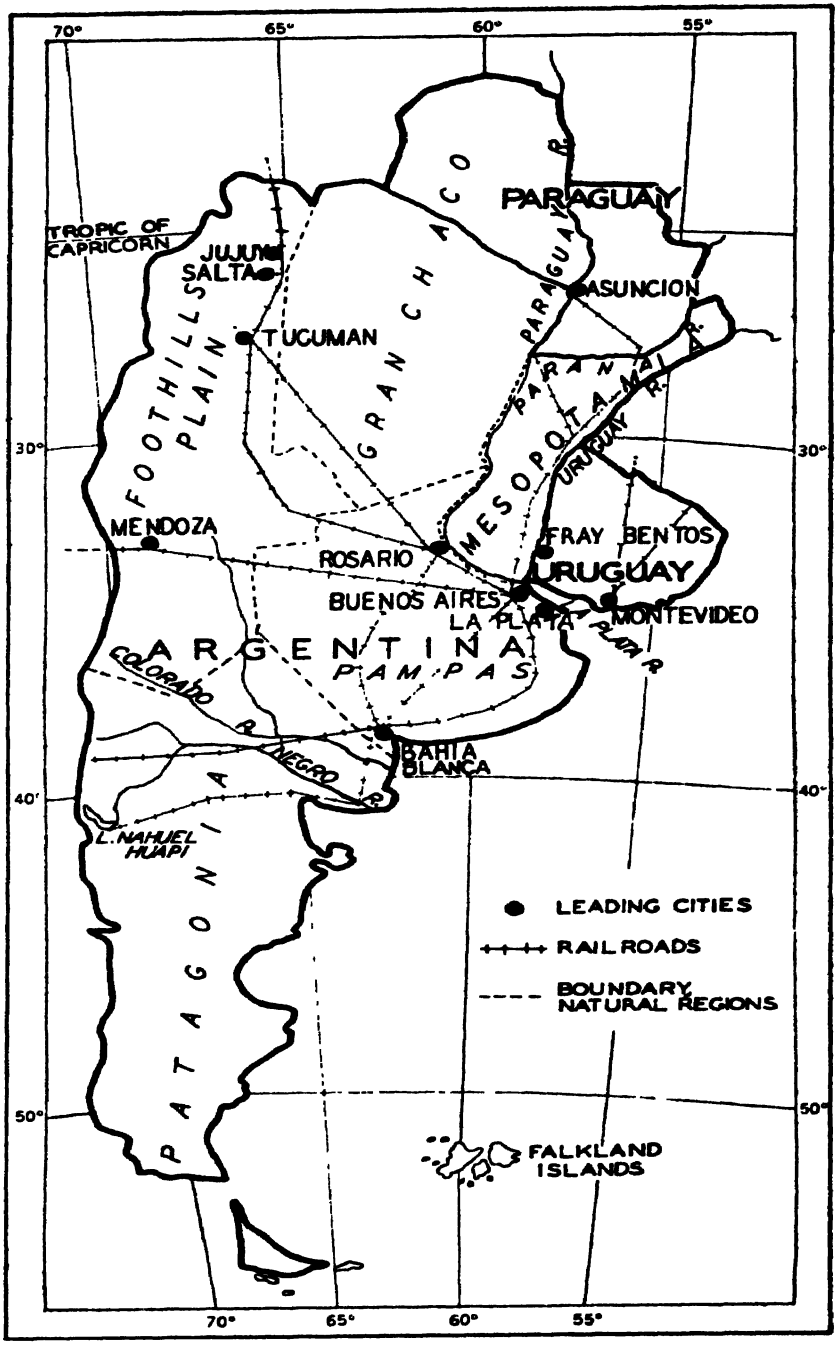


Fig. 246. Argentina, Uruguay, and Paraguay.

The Plata River is a shallow estuary, 138 miles in width at its mouth, formed by the union of the Paraná and Uruguay Rivers. It silts rapidly and requires constant dredging to keep a narrow passageway open for ships. The port of La Plata was built below Buenos Aires to overcome difficulties in getting into the older port.

ARGENTINA

Geographic features. Argentina may be divided into five sections: the pampas, which are the heart of the nation; the subtropical Chaco; the mesopotamian area; the desert at the foot of the Andes in the northwest; and Patagonia.

The pampas are the grasslands to the south and west of Buenos Aires, flat and with many lakes and a deep, fertile soil. On the west and south they merge into arid and semiarid land and on the north into the subtropical forest and savanna region, called the Chaco. The Chaco, which also extends into Bolivia and Paraguay, is a level, partially swampy plain, broken by forests and straggling clumps of palm trees. The mesopotamian region, which lies between the Paraná and the Uruguay Rivers, is hot, humid, and swampy and is therefore undeveloped. The desert in the rain shadow of the Andes is largely a foothills plain with fertile productive spots where it has been irrigated. Patagonia is a bleak plateau, fit for little but the grazing of sheep and goats.

Climate. The pampas have moderate rainfall, heavier near the ocean, and are normally free from hard frosts or severe heat. Droughts often occur, however, as do also hailstorms and thunderstorms, with heavy losses resulting. The eastern part has both summer and winter rainfall, the western part chiefly summer rainfall. The Chaco is hot; it is moist in the south; and in the north it is a steppe land with scattered hardwoods, some parts of it being similar to the cotton belt of the United States. Patagonia is cold and dry except at the southern end, where the Andes are low enough to permit rain-bearing winds to blow all the way across. There it is cool, moist, and windy. The rain falls chiefly in the winter, and the western edge is the best-watered part.

Large estates. In the better parts of Argentina the land is held mainly in large estates obtained when only the animal industries were important. These large holdings seem to have retarded development. The natural conditions are so favorable, the estates so large, and the costs of maintaining them so low, that their owners can make good profits simply by grazing animals. Therefore,

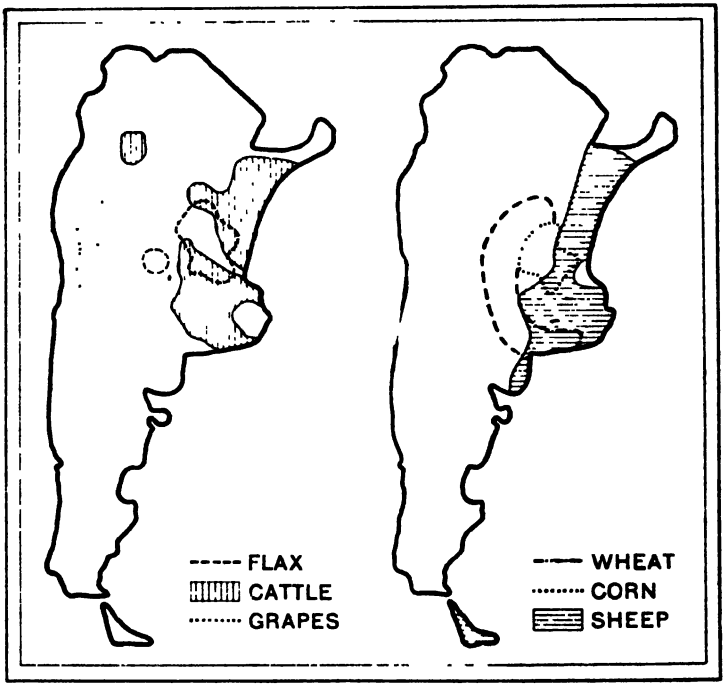


Fig. 247. Crop- and animal-producing districts of Argentina.

when immigrants come to the country, it is difficult to obtain lands except by going into the subtropical north. It is even very difficult for crop production, which is itself conducted on a large scale, to compete with the cattle and sheep industries for land in the eastern pampas. Much good crop land is thus still held in large ranches for grazing purposes.

Immigrants also find it difficult to own land in the grain-growing sections, but they can get land to farm, because the cereals are grown on the estates to a large extent by tenants under some type

of contract. It may be a long time before economic influences force the owners to divide their estates. The government recently has been sponsoring a movement to break up certain of the large holdings. Colonists have been going to the northern part, and many more would probably go were there more railways. The Jewish Colonization Association has acquired a half million acres of land in this section. One third of the land is still owned by the government, much of it good grazing land which may be obtained under easy terms.

Agriculture. Only about 25 per cent of the land of Argentina is adapted to crop production; 6 per cent of the cultivable portion is too dry to farm without irrigation, and animal industries occupy about a third of the arable land in use. The total area of grazing land, however, is about four times the acreage of the used arable land. Although the main animal and cereal centers are in different places, there is mixed farming and grazing in the cereal districts, and two or more of the grains are often grown on the same farm. Many ranches also raise cattle, swine, and sheep. Cereal farming is often only preliminary to the planting of the land to alfalfa, which is pastured. During the past decade crop production relative to animal industries has increased.

Crops. The distribution of crops is controlled largely by rainfall (Fig. 234). The principal crops (Fig. 247) are corn, wheat, and alfalfa, and flax is also important. Since alfalfa is pastured, it will be discussed with the animal industries.

Corn, the most important crop, is grown in the wetter, warmer part of the grasslands, where the climate is similar to that of the lower Mississippi Valley. Annual production recently has averaged 332 million bushels. Although only 13 per cent greater than the corn production of Illinois, it required double the acreage. Acreage in corn has more than doubled since 1925. Because of the small number of swine and the year-round pasturing of other animals, no very large domestic market for corn exists. As a consequence, 70 per cent or more of the crop is exported, Argentina leading the world in this respect. The principal markets are in

the British Isles, France, and the Low Countries, where, because Argentine corn has small kernels adapting it to poultry feeding, because its sweetness makes it a better feed for horses than corn from the United States, and because a moisture content that is lower than that of our corn makes it easier to ship by water, it commands a premium of as much as 10 cents per bushel.

Winter wheat is grown on the drier, cooler edge of the grasslands to the west and southwest of the corn and animal districts, where usually the winters are open and dry and the summers moist. Considerable damage often is done by drought, hot winds, late frosts, and locusts. Obviously this is not the ideal wheat climate, but economic factors are favorable enough to offset these disadvantages for the present at least. Since labor is scarce and the estates large, American machine methods are employed. Annual production recently has averaged 225 million bushels, 30 per cent more than the normal output of Kansas. As with corn, 70 per cent of the crop is usually exported, mainly to Europe.

Seed flax is grown principally in the corn and wheat districts, often as a sod-breaking crop preceding either cereals or alfalfa. Production has increased 25 per cent during the past decade. Practically the entire crop is exported, mainly to northwestern Europe and the United States.

Remaining cereals, grown largely for export, are more important in the cooler southeastern part of the Province of Buenos Aires.

Sugar cane is an irrigated crop produced mainly in the Tucumán and Jujuy districts. In the former it occupies half of the cultivated land. The latter has better natural conditions but is less densely populated and farther from market than the Tucumán district, where a short season and plant diseases are problems.

With irrigation there might be an important cotton industry in the sugar-cane districts. This crop is expanding rapidly in the Chaco, where a much greater acreage will be possible when transportation becomes available.

The leading fruit is grapes, largely for wine, grown under irri-

gation on alluvial fans between San Rafael and San Juan. Mendoza, on the Trans-Andine Railway, is the most important center. The grape and wine industry has a capital investment of $200,000,000. Middle-latitude fruits are grown in the grape districts, in the Delta section near Buenos Aires, in the Jujuy district, where the warm climate causes earlier ripening than in other places, and along the Rio Negro, where the hardier types are grown and where ripening is later than in the other centers. Considerable quantities of these fruits are shipped to the United States during our winter.

Animal industries. Before railways were built, animal products were almost the only ones that could be marketed, and before refrigeration only hides and wool, live animals, bouillon, and dried meats could be shipped. In the earliest period hides and wool were the principal exports. Many animals were slaughtered with no use made of the meat. The bones of the animals, which are still gathered from the plains and exported for use in the manufacture of fertilizer, were a by-product of the early days. The grazing lands are subject to severe droughts, some of which kill thousands of animals, but alfalfa and the widespread use of windmills have partially overcome this difficulty. Grazing is on large estates, many of 25 to 50 thousand acres or more, called *estancias.* The cattle industry is in Spanish hands, and the sheep industry largely in British hands. Of the present total of 90 million animals, sheep comprise 45 per cent, cattle 33, and draft animals 12. During the past 15 years sheep have increased in importance relative to cattle, which may be a reflection of the increasing acreage in crops.

Alfalfa. There are 14 million acres under alfalfa, which is used largely for pasturing cattle. Swine graze on it, but sheep do not thrive on it. Except for the irrigated districts of the west, the western edge of the alfalfa-growing region coincides almost exactly with that of the wheat region. From there it extends eastward until it includes about half of the Province of Buenos Aires, east of which it does not thrive because of the more moist climate and

the poorly drained soil. About half of the irrigated land of Argentina is planted to alfalfa. The San Rafael district produces nearly all of the seed used in the country. Alfalfa is desirable because a given area of land in the crop will support eight or ten times as many cattle as the native grasses do, and it does not dry up during the dry season, during droughts, or during the winter months. Animals fattened in Argentina are grass fattened; and alfalfa not only produces a superior quality of beef, but also fattens the animals more rapidly than the other grasses. In severe winters the cattle are fed oats, but this feed is considered to be rather expensive, compared with grass pasture.

Cattle. Nearly half of the cattle of Argentina are concentrated in the Province of Buenos Aires. The nearness to the ocean of these grasslands and of those across the river in Uruguay has been important in their development; nowhere else in the world are there such extensive areas of a similar nature so near the ocean. Since the exported products are shipped mainly to Europe, ocean haulage makes possible exceptionally low freight charges. Furthermore, the level nature of the pampas has made the building of railways so easy and cheap that the short rail hauls to seaports are possible at minimum costs.

Originally the cattle were of poor quality, being the wild descendents of cattle introduced early by the Spanish. Recently, however, fine breeding stock has been introduced from the United States and Great Britain, and, consequently, there is now little difference between the cattle of Argentina and those of the United States. The Shorthorn breed predominates. The Chaco seems to be a potential cattle-grazing area.

Sheep. Sheep are grazed everywhere except in the dry foothills of the Andes and in parts of the Chaco. The Province of Buenos Aires has a third of the total number. A smaller district is the cool, moist southern tip of the continent. In the pampas with its good pastures, the sheep are now all of the mutton type. To the north of this region they are grown more for their wool, while at the southern end a dual-purpose type is raised. Although

the latter district produces a white wool of good quality, the average South American wool is an inferior grade.

In Buenos Aires many of the sheep estates contain 25,000 acres or more; in southern Patagonia "many holdings embrace more than two million acres; one in the Punta Arenas district of Chile, valued at seven million dollars, grazes 1,200,000 sheep, 20,000 cattle and 9,000 horses, shears more than a million head per year, and produces vast quantities of mutton."[1] There is a total of over 11,000,000 sheep at the tip of South America. There are large packing plants, chiefly at Magallanes.

The shearing season is in early spring. There is danger in clipping the wool too early because unseasonably cold weather may result in the death of many sheep. On one large *estancia* where there are about 103,000 head, they are sheared at the rate of 6 or 7 thousand per day.

Dairying. The open winter with year-round pasturage and the large supply of grains create excellent conditions for dairying. The industry has been expanding rapidly near the city of Buenos Aires. Butter and cheese are exported to Europe, and Argentina exports nearly 75 per cent of the world export of casein.

Goats. Goats are grazed in small herds in the rough dry region to the west and northwest of the pampas. They are raised chiefly for their skins, which provide the main export of this region. They are herded in small flocks by individual families of Italian and Spanish settlers.

Swine. Swine, whose number has been increasing recently, are grown chiefly in the corn region. The industry has grown slowly because of the lack of an important domestic market for pork, and because it is a more intensive type of animal industry than grazing, thus requiring more labor. The animals feed on alfalfa and corn. Because of the open winters and excellent commercial location, Argentina can export pork to the eastern seaboard of the United States more cheaply than it can be sent there from Iowa.[2]

[1] Clarence F. Jones, "Agricultural Regions of South America," *Economic Geography*, 4:171.

[2] *Ibid.*, p. 18.

Minerals. Argentina lacks minerals even of the baser sort for construction and road-building purposes. The chief mineral resource, found in the northwest and in Patagonia near the Gulf of St. George, is petroleum. About two thirds of the domestic requirements are met from these sources. There are small supplies of other minerals in the mountains, and it is possible that further exploration will disclose deposits not now known.

Trade with Great Britain has always made it easy to obtain coal as a return cargo on the ships that carry food products and raw materials to that country. But the Empire-preference policy and the new agricultural policy recently adopted by the United Kingdom may disrupt this trade to some extent.

Nor does Argentina possess water-power resources. It is hoped that hydroelectric energy may in time be obtained from some of the falls of southern Brazil, particularly the Great Falls of the Iguassu, where the highest of a series of falls has a drop of 210 feet.

Manufacturing. The fact that 60 per cent of the people of Argentina are classed as urban does not necessarily indicate that manufacturing is important; this high percentage may be because many large landowners live in the city, leaving the estate in charge of a manager, and because of the importance of commerce. The annual value of manufactures is less than one billion dollars, and less than half a million people are employed in factories. The lack of power and of a large domestic market are handicaps to the development of complex manufactures; but in spite of this, various industries are being encouraged with protective tariffs.

The principal industries are those which process agricultural products. Meat packing contributes 20 to 25 per cent of the value of all manufactures and is followed by wine making. Buenos Aires has the largest meat-packing plant (*frigorifico*) in the world. It has a daily capacity of 5,000 cattle and 10,000 sheep. Foreign companies own packing plants, that of one of the American companies being more modern than its home plant. Other industries

are the manufacture of textiles, tobacco, sugar, tanning materials, flour, and metallurgical products.

Quebracho. From forests, which cover 20 per cent of the country, Argentina produces about 80 per cent of the world's quebracho extract, a tanning material taken from the heartwood of a tree of medium size which grows in scattered stands on the higher parts of the hot lowlands. Susceptible to differences in elevation, the trees run out at short distances from the rivers. This is thought to result from differences in the moisture content of the soil. The main area of production is along the west side of the Paraná-Paraguay Rivers, extending from northern Argentina into Paraguay. The trees in the more southern locations are richest in tannin. In manufacture the heartwood is reduced to chips by machines, after which it is treated with boiling water or steam at high pressure. The resulting liquid is condensed and then drawn into boxes, where it solidifies. A great deal of labor is necessary to remove the bark and the sapwood from the logs, one man's output being about 15 tons of logs a month. The branches of the trees are used for fuel by the railways that haul the logs to the factories. Some logs are exported for the extraction of tannin. Quebracho, one of the heaviest and toughest of woods known, is used for railway ties in Argentina and elsewhere. In some cases it has been in use over 30 years and shows little sign of deterioration.

The industry is under the control of corporations that have an investment of $75,000,000. Though the corporations have their own forests, they also buy logs.

Transportation. Argentina has good railway facilities where they are needed most, but it will need much additional mileage before it will be able to develop fully. Eighty per cent of the mileage is privately owned, two thirds by British capital. Since the British need foodstuffs and raw materials from foreign countries and are dependent on foreign countries for markets for their manufactures, much of their investment in foreign countries is in

railways. In Argentina the lines for the most part radiate from Buenos Aires, but also from several of the other large cities. The Trans-Andine line and the connection with the Bolivian railways have been referred to previously. A line is being built from Salta to Antofagasta in Chile, while in the south a line is being built inland from the port of San Antonio to extend ultimately into Chile. There is another line from Bahia Blanca that may finally reach into Chile and another from Viedma to Lake Nahuelhuapi. The latter route, popular with travelers going from Argentina to Chile, is being settled by immigrants.

Progress has also been made in constructing highways. There is a Trans-Andine highway to Chile along the same general route as the railway connecting the two countries. Highways are expensive because of the lack of materials in the country out of which to construct hard-surfaced roads. They will be of great aid, however, because the relative dryness of the country now causes a thick layer of dust on the highways, which makes cumbersome wagons and much draft power necessary to move products.

Foreign commerce. During the past 15 years the foreign commerce of Argentina has been two thirds as valuable as that of Canada, the per capita value being relatively high. For many years previous to 1930 the values of imports and of exports were not far different, although exports were always greater; since then imports have declined relative to exports, a result of the expansion of manufacturing. Agricultural commodities comprise almost 60 per cent of the total exports, and animal products almost 40 per cent (Fig. 248a). The former have been gaining during the past decade. Imports are chiefly manufactured products and fuels (Fig. 248b).

The United Kingdom recently has purchased about a third of the exports and has supplied a fifth of the imports. Argentina has the foods and raw materials which the British need; the British have the coal and manufactures which Argentina requires. The United States has normally exported much more to Argentina than it has imported, and previous to 1931 we supplied 20 to 25

per cent of the total imports; recently we have contributed about 15 per cent. Usually we buy a little more than half that proportion of Argentina's exports. Our leading exports are motor vehicles, industrial and agricultural machinery, petroleum products, iron and steel, and lumber; the leading imports are hides and skins, wool, flaxseed, quebracho, and canned meats. Belgium, the

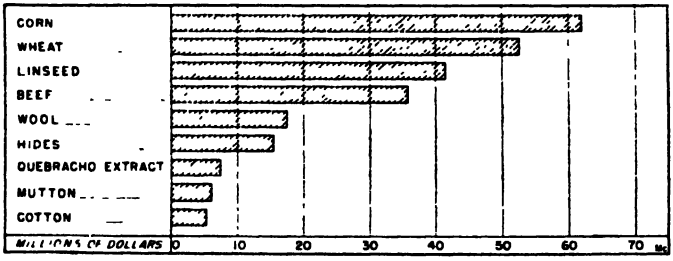


Fig. 248a. Principal exports of Argentina in 1935.

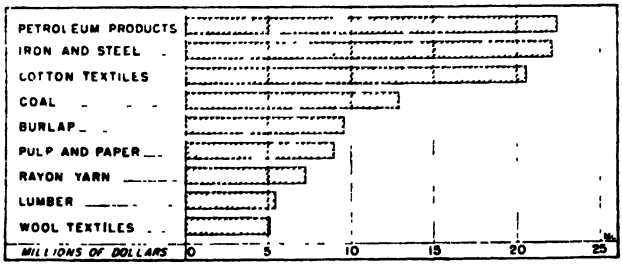


Fig. 248b. Principal imports of Argentina in 1935.

Netherlands, and the German Reich are also important in the foreign trade of the country.

Buenos Aires, Rosario, and Bahia Blanca are the principal seaports. They handle the bulk of the grain and most of the other exports. The largest grain elevator in the Southern Hemisphere has been built recently at Bahia Blanca. La Plata is important in shipping animal products.

URUGUAY

Climate. Uruguay consists of extensive rolling plains which are savanna rather than pampa. It has heavier rainfall than the

pampas, the greater part falling from May to October, a period during which cold storms blow from the southwest and frequently cold winds from the Atlantic. Average temperatures are moderate because so much territory is subject to the influence of the ocean. The winters are similar to those of Florida, the summers like those of Maryland. The southeastern coast has pleasure resorts frequented in winter by people from Argentina and Brazil.

Agricultural products. Although 90 per cent of Uruguay is suited to tillage, 60 per cent is in pasture and only 7 per cent in tilled crops; most of the remainder, however, is used for mixed pasturing and farming. It is thought that animal industries have reached their peak of development. There are 2½ times as many sheep as cattle; other animals are largely lacking.

The acreage in all of the more important crops has been increasing recently. Wheat, with an annual production of about 12 million bushels, is the leading crop. Corn occupies half as much acreage as wheat. Other crops are flax, oats, grapes, and oranges, the last two being grown near Salta. Oranges are exported to Buenos Aires.

Manufactures. Meat packing is the leading industry. There are four large *frigoríficos,* three in Montevideo, the leading city and seaport, and one in Fray Bentos. The latter is the largest beef-extract plant in the world, with a daily capacity of 2,000 cattle. Other manufactures are flour milling, leather goods, furniture, and textiles.

Transportation. Ninety per cent of the railway mileage is owned by British capital. The lines radiate from Montevideo and touch Brazil in three places, connecting with the Brazilian lines at two of these points. On some of the lines refrigerator service is provided for meats, dairy products, and fruits.

Foreign commerce. Animal products, of which wool, hides and skins, and canned meats are most important, are normally about 85 per cent of the total exports. There are small quantities of wheat and flaxseed. Petroleum products are usually a quarter

of the imports. Other items are textiles, sugar, coal, yerba maté, olive oil, and potatoes. Exports are usually greater than imports, and the total trade is about as valuable as that of Peru. Distribution of trade is similar to that of Argentina, except that the German Reich is relatively more important.

PARAGUAY

Backwardness. Inaccessibility, subtropical climate, population largely of Indians, and wars have all retarded the development of Paraguay. From 1865 to 1870 the country fought the combined forces of Brazil, Argentina, and Uruguay and as a result suffered a decline in population from about 1,400,000 to 220,000. Colonization may have an important part in the future of the country. The Mennonite colony, in the district west of Puerto Casado, which has had moderate success in equipping itself for modern living, is the first one. Government officials have thought of making a serious attempt to attract other persecuted religious sects. There are good conditions for agriculture, large areas of grassland, and forest resources. Railways are lacking except for two lines southward from Asuncion through Argentina.

Geographic features. Paraguay is largely lowland with a fertile soil. The western part is composed of the young formations of the Chaco, while in the east occur ancient rock formations and considerable rough country. In several places the soil is adapted to special crops.

Climate. Temperatures often go above 100° in summer and fall below freezing in winter. The weather is subject to sudden changes of temperature with abrupt shifting of the wind direction from north to south, which brings rain and cooler weather, often so cool, especially in the southwest, that crops are endangered by severe frosts. Normally rainfall is adequate and well distributed, although there are occasional droughts.

Industries. The leading economic activities of Paraguay are the grazing of cattle and the production of cotton and of quebracho

extract; others are the production of tobacco, oranges, petitgrain,[3] and yerba maté. The beef, of poor quality, is made into extract and canned beef. Four packing plants are now operating under government encouragement. American and British capital has started recently to develop both cattle and forest interests.

Cotton of excellent weaving qualities, grown by colonists in the region below Asuncion, has recently become the leading crop. There seem to be possibilities for this crop, but the scarcity of labor retards the industry.

Tobacco, next to cotton in importance, is grown to the east of Asuncion in a district with red, sandy soils and a climate peculiarly adapted to Cuban varieties. Cigars and cigarettes are both manufactured for domestic use.

Conditions are ideal for oranges, and a native variety grows wild everywhere. Exported to Buenos Aires, they are now meeting increasing competition from the better Brazilian product. Grapefruit are sent to the London market, the crop maturing at a different time than in other countries, and banana production is starting. There is an annual output of about 80 tons of petitgrain oil, which is used in perfumes and flavoring extracts. It is made in small stills near Yaguron, and from 300 to 350 pounds of leaves are required for one pound of oil.

Yerba maté. Paraguay leads the world in the production of yerba maté, or Paraguay tea, obtained from a small tree resembling an orange tree, which grows throughout this section of South America, usually in scattered stands. Though yerba maté is an important drink in South America, attempts to popularize it in other parts of the world have not been successful.

In harvesting, branches are cut from the trees and passed over a fire to toast the leaves, which are then stripped and toasted further in an oven. A large part of the production comes from wild trees, but consumption is large enough so that several plantations have been established. About half of the production is exported. It

[3] An essential oil that is distilled from the leaves of the bitter-orange tree.

has a stronger aroma and more pleasing taste than that produced in the neighboring countries, and some is used for blending with the poorer varieties.

Foreign commerce. Cotton and quebracho extract each has recently comprised about 20 per cent of the total exports, and hides and beef, chiefly extract, each 12 per cent. Cotton textiles and food products each form a quarter of the imports, and vehicles and petroleum products each 10 per cent. Exports normally are slightly greater than imports, and the total value of both is about 20 per cent of that of the foreign commerce of Uruguay. Usually 40 per cent of the exports go directly to Argentina and 50 per cent move in transit through that country for export, while 60 per cent of the imports come from there.

Asuncion is the leading port. At high water the Paraguay River accommodates boats of 12-foot draft and at other seasons boats of 7-foot draft. Boats can navigate the river for a long distance above Asuncion. British capital is invested in both railway and waterway companies.

BRAZIL

Geographic features. In Brazil four topographic regions may be recognized: the narrow, fertile coastal plain with its tropical climate; the eastern highlands; the savanna south and west of the highlands; and the Amazon basin. Two thirds of the country is unoccupied except by Indian tribes, and their numbers are small. The majority of the people live in the highlands and in the adjacent coastal plain.

Climate. Except for highlands where elevation tempers the heat, Brazil has the hot, moist tropical and equatorial types of climate. All of the country lies south of the annual thermal equator. In addition to elevation of much of the land, the long coast line and the large amount of water surface made by the streams help to temper the climate.

The coastal plain is in the path of the southeast trades as they



Fig. 249. Leading cities and railways and the coffee-growing district of Brazil.

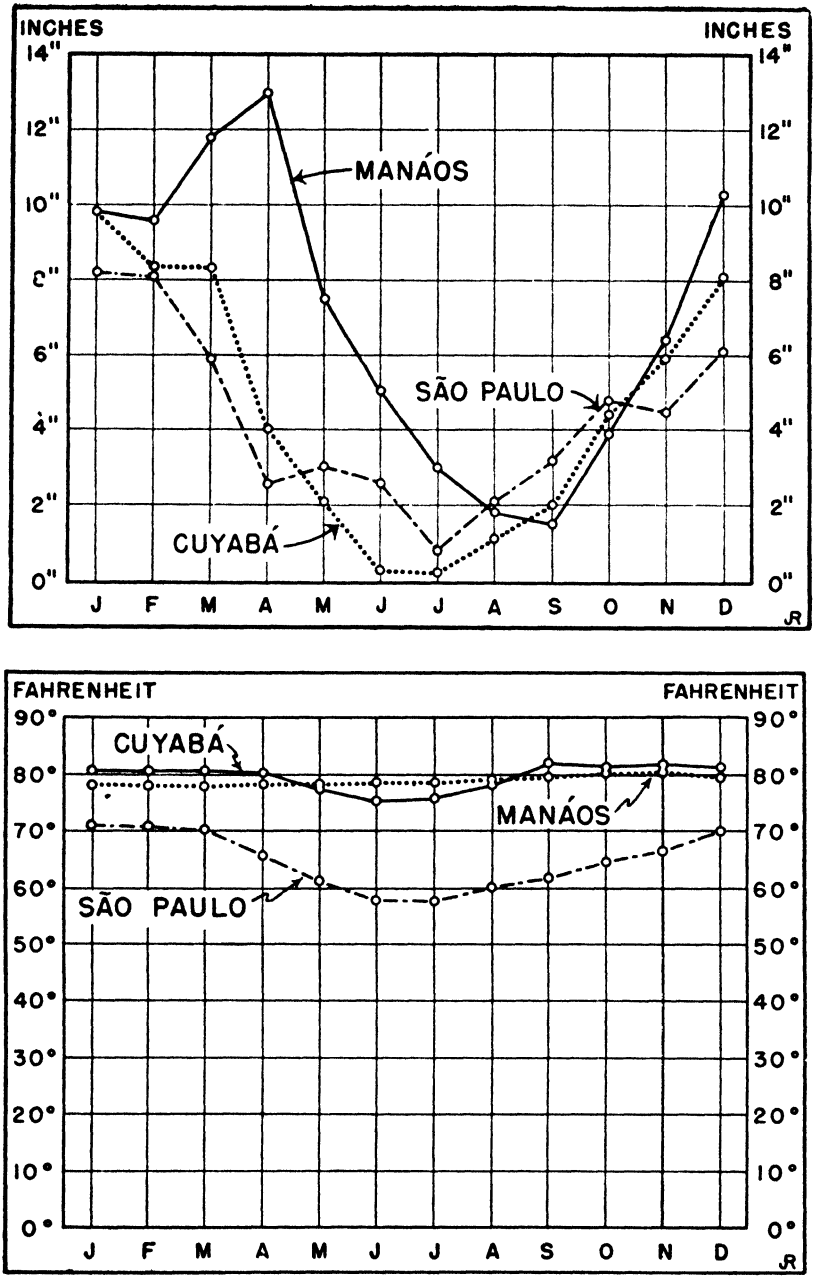


Fig. 250. Monthly rainfall and mean monthly temperatures for selected stations in Brazil. (Figures for Manáos and São Paulo are from Kendrew; those for Cuyabá are from the World Weather Records.)

strike the front of the highlands, and in most places, therefore, it receives heavy rainfall. The highlands are a region of moderate rainfall except for a few places in the northeast, which are almost desert. The grassy lowlands in the interior have about the same amount of rain as the coastal plain, and the main part of the Amazon Valley has heavy rainfall. Heavy rainfall here is caused by location in the doldrums and by the long distance over which the winds must blow, and by the gradually rising elevation toward the crest of the Andes, which takes nearly all the moisture possible from the winds. Although summer rainfall is heaviest, most parts except the highlands have a double rainy period.

Forest products. In the Amazon basin Brazil probably possesses more abundant wealth of forest products and medicinal plants than does any other part of the world. Rubber was formerly the leading product, but its value is insignificant now when compared with that of some of the cultivated products, and the production is negligible because of the impossibility of competing with plantation rubber. There are about a million square miles of rubber-bearing forests in the country and additional areas in the neighboring countries. These lands belong largely to the respective governments and are worked under concessions. Some of the states of Brazil have attempted to develop a plantation industry by offering blocks of land and subsidies to responsible companies. Small plantations have been established along the lower Madeira, Manes, and Topajos Rivers; Henry Ford has a large plantation in the experimental stage along the lower course of the last one. Only hardwoods are being shipped to the United States at present from this plantation. There are large areas of hardwoods which go unused because they are less accessible than other supplies to the markets of the world.

Brazil is the leading source of carnaba wax, which is used for electrical insulation, phonograph records, and other purposes. It is also the chief source of Brazil nuts, which are gathered and prepared for market by the Indians along the lower Amazon. The industry has been expanding recently because of the estab-

lishment of trading posts farther inland. A fact not generally known is that these nuts are pressed to obtain a fine quality of oil used in watchmaking.

There is a large area of pine in the southern part, and lumber is now being shipped from the State of Paraná to Argentina and Uruguay. The same region also ships cedar to Rio de Janeiro and Bahia, to be made into cigar boxes.

Minerals. Brazil is thought to have immense mineral wealth in the eastern highlands. For a decade or more gold has led in value in mineral output and now contributes about 60 per cent of the value of all minerals. Coal is about half as important as gold. Gold mining is largely by placer methods. For monetary reasons the exportation of gold has been prohibited since 1918. Before Africa became important, Brazil led the world in production of diamonds, which are still mined from alluvial deposits in the upper São Francisco Valley and in southern Matto Grosso; the output is, however, of the type used for drilling in hard rock. Such diamonds are not valuable as gems, but without them the deep drilling of wells through hard rock would be very difficult.

The leading mineral export now is manganese, which goes largely to the United States and Belgium. Along the shores of Bahia and in Espirito Santo are the world's principal sources of monazite, which is used chiefly in the electrical industry. What are thought to be the world's largest reserves of iron ore occur in Minas Geraes. They are owned by foreign capital, American being important, and development is being started at Itabira. A deposit of nickel was recently discovered at Goyaz. There are reserves of about 5 billion tons of coal of poor quality mainly in the southeastern part.

Water power. Brazil has an immense amount of potential water power, located favorably with respect to centers of population and to supplies of various minerals and other raw materials. There are over 375 waterfalls with 50,000,000 horsepower of potential energy. About 1,000,000 horsepower are now developed in about 500 plants.

Agriculture. Brazil is potentially a great agricultural country. At present less than one per cent, 17 million acres, of the land is cultivated. Nevertheless the country ranks first among the countries of the world in the production of coffee, second in cacao, third in sugar, corn, tobacco, and swine, and fourth in cattle. Most of the cultivated land is in the coffee states of São Paulo and Minas Geraes and in the mixed farming and grazing state, Rio Grande do Sul. The best agricultural lands are found in the coastal plain and in the wetter eastern part of the plateau. The methods employed are crude and inefficient, cotton, for example, often being grown among charred logs without any cultivation. The average farm is small.

Crops. The principal food crops, some of which are exported, are manioc, corn, rice, beans, sugar cane, and fruits; the leading money or export crops are coffee, cotton, cacao, tobacco, and yerba maté. A third of the cultivated area is in corn, a fourth in coffee, and a seventh in cotton; the output of each of these is about equal in value; together they account for half the total agricultural output of the country.

Both manioc and corn are grown widely, the former mostly near the centers of population along the coastal plain, the latter in the lower Amazon Valley and in Rio Grande do Sul, where it occupies half the crop land. Soft corn is generally grown because there is no dry ripening period; it makes poor feed and cannot be exported. The production is about two thirds that of Argentina. In the south, beans rank next to corn in acreage, and some potatoes are grown in the cooler sections. Rice, largely of the upland variety, is found throughout the coffee region; its production is concentrated in the western part, and it occupies the valley floors along with other cereals. Brazil has changed recently from an importer of rice to an exporter. Sugar cane is grown in the coastal plain and the river valleys of the Recife district, and in eastern Minas Geraes and its adjacent coastal plain. There is a small export of sugar. Different kinds of tropical fruits are grown and consumed in large quantities, the orange being of the greatest

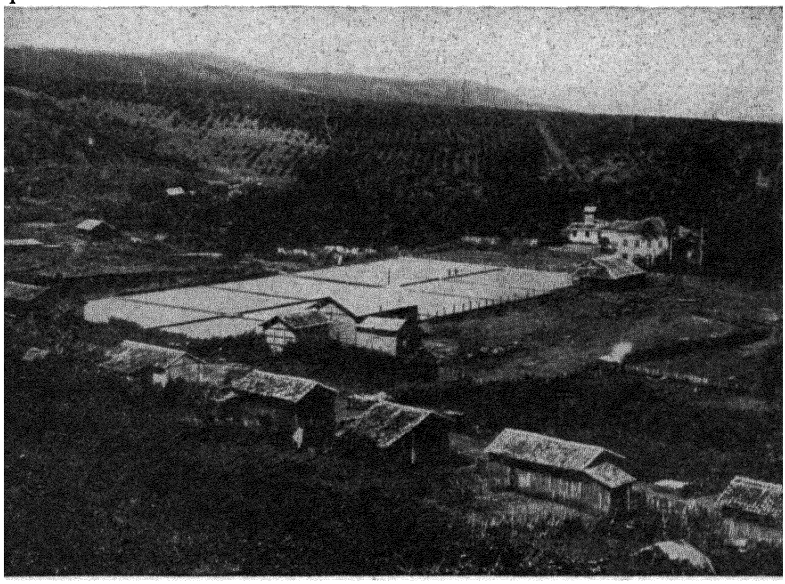
commercial importance. Brazil with 33 million boxes in 1935 ranks next to the United States in orange production. Almost the entire crop is consumed within the country, but exports to Great Britain and Argentina are increasing. Bahia grows some of the largest and most delicious oranges in the world.

The State of Pernambuco leads in the growing of cotton, followed by São Paulo. Acreage has gradually increased since the World War, and since 1933, partly because of acreage control in the United States, it has doubled. Output recently has been about 15 per cent that of this country. There are millions of acres of potential cotton lands. In order to increase the supply of raw material for an expanding cotton-textile industry, the government has offered attractions to foreign capital in the form of concessions and other privileges. Tobacco of high quality, used principally for cigarettes, is grown in the same region with sugar cane. Natural conditions for cacao are excellent, but unscientific methods, scarcity of efficient labor, and an export tax of 20 per cent retard expansion. The crop is grown by small cultivators in clearings in the forest, largely in the coastal plain of Bahia. Yerba maté grows in the interior near Paraguay and is consumed widely in spite of the importance of coffee.

Coffee. The advantages of Brazil over other coffee-growing regions are (1) the large area adapted to the crop, (2) the simultaneous ripening of the berries, which is important on account of the necessity for seasonal labor; and (3) better transportation. The requirements for successful coffee production are (1) highlands with a mild climate and free from frost, since coffee produced in the lowlands is of poor flavor, (2) annual rainfall of about 75 inches with a dry harvesting season, (3) well-drained, residual soil of high iron and potash content, (4) absence of insects and plant diseases, since the tree is peculiarly subject to disease, and (5) protection from the hot rays of the sun, at least while the tree is young. The worst enemies of the coffee tree are cold and hot, dry winds.

Brazil grows 70 per cent of the world's coffee, and two thirds

of the crop comes from São Paulo, which has the world's largest area of the required type of soil. Coffee could be grown on an area nearly half as large as the United States. At present there are about 3 billion trees divided among 40,000 *fazendas,* the majority of which vary in size from 500 to 1,500 acres. The world's largest fazenda contains 10,000 acres, with $4\frac{1}{2}$ million trees and requires 6,000 workers. Another owner has several fazendas with



Pan American Union. Nat'l Coffee Roasters' Ass'n.

Fig. 251. Brazil: A coffee plantation in the State of São Paulo.

a combined total of 8 million trees, requiring about 10,000 workers. At one time this owner's profits were over $1,000,000 annually. Brazilians own half of the fazendas, Italians a quarter. The trees are on the slopes of the highlands at elevations varying from two to four thousand feet. The mean annual temperature of the coffee district is 70°, but there are variations ranging from freezing to over 100°. Freezing occasionally causes heavy losses by killing the trees.

The extra labor needed at harvest time for picking and for drying is often difficult to obtain. The Italians are important because

of the reversal of the seasons, which permits them to go back to Italy in the northern summer. The Japanese, whose experience in picking tea is an advantage, have been migrating to Brazil to work in the coffee orchards and to settle in the country. Pickers usually receive 3 cents per gallon. During the remainder of the year only enough workers to hoe and fertilize the orchards are needed. Four or five weedings are necessary each year. One person can care for about 3,000 trees, for which he earns about $150 for a season. Many of the permanent workers have families, with several in the family working. A plot of ground for raising food is furnished the head of each family.

The coffee industry of Brazil has been in a depressed state since 1920 because of the overexpansion that resulted from the high prices promoted largely by a coffee-control scheme antedating the World War. The government, in trying to aid the industry by a price-stabilization scheme, has destroyed enormous quantities, and in 1931 it passed a law which forbade the planting of more trees for a period of three years. Conditions, however, are still bad. Encouragement has been given to the diversification of agriculture, and many trees have been uprooted and the land planted to other crops. Silk culture has also been introduced on the fazendas. Brazil has excellent conditions for the growing of mulberry trees but lacks the proper type of labor for caring for cocoons. The Japanese and the Italians may impart their knowledge and skill to the natives, and in time this difficulty may be overcome.

Animal industries. Good conditions for ranching exist throughout the highlands and in the grasslands of the south and southwest. Matto Grosso with the adjacent parts of Bolivia and Paraguay is the largest unused but promising grazing region to be found. Of the 95 million animals of the country, slightly more than in Argentina, half are cattle, 25 per cent swine, and 12 per cent sheep. The animals are inferior in quality; they do not make good meat, and the climate is too warm to produce good wool.

Rio Grande do Sul is the leading animal state, having most of the sheep, 25 per cent of the cattle, and 20 per cent of the swine. Cattle, raised in all settled sections, are used much for draft purposes except in the south. In the central highlands they are found in locations that are too high for coffee. Pork is an important article of diet, and swine are either fattened on corn or allowed to run in the forests to fatten on nuts and roots. The dry area at the northern end of the highlands is one of the world's important sources of goat skins.[4]

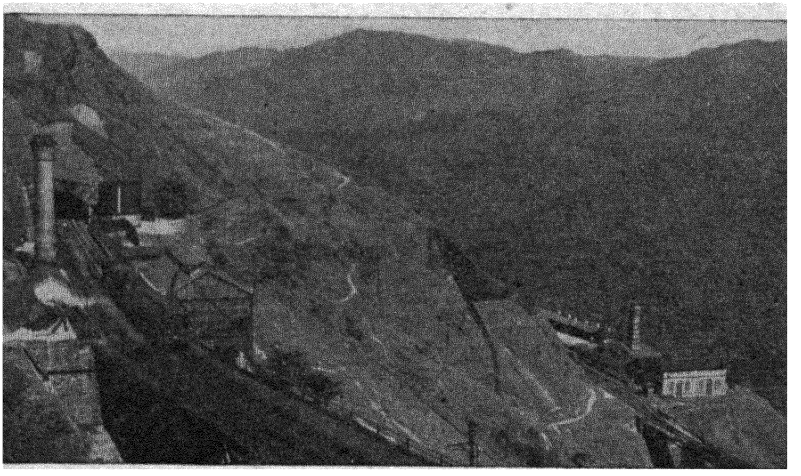
Manufactures. Manufacturing is not yet important in Brazil, but there are promising possibilities and gradual progress is being made. Scarcity of coal and of transportation, sparsity of population, and the low standard of living of most classes are retarding factors.

The leading manufacture is cotton textiles, chiefly in the states of São Paulo and Minas Geraes. There are about 2½ million spindles. Protection is given the cotton-manufacturing industry in order to create a market for home-grown cotton. There are also silk, wool, and jute factories. The other manufactures are concerned largely with processing the products that are grown. Meat packing is important in the south and at Fortaleza on the northeastern coast. Dried-meat and salted-meat works and extract factories dominate this industry, since the majority of the animals are not of a quality that will make good chilled meat. Although the Brazilians have a high enough standard of living to demand white bread, but little wheat is grown. Large quantities are imported from Argentina, Uruguay, and the United States, and are milled at Rio de Janeiro. The ships from the United States can take a return load of coffee. Leather goods, sugar, furniture, tobacco, and paper are other manufactures.

Transportation. Considering its size, Brazil has a low railway mileage. Population, however, is concentrated, and the areas where transportation is most necessary are fairly well supplied.

[4] Since 1930 enough dams have been built in this section to provide irrigation water for 67,000 acres of land.

Almost half of the mileage is in the states of São Paulo and Minas Geraes. For the most part lines radiate inland from the main seaports, and government plans are rapidly being realized for connecting the ends of these lateral lines with branch lines to stimulate the development of the interior. Plans provide for the construction of lateral lines further to the west. It is thought that the line to Corumbá will be extended into Bolivia, thus making a transcontinental line, and that a railroad may be built



Pan American Union.

Fig. 252. Brazil: view of the railway which runs between Santos and the City of São Paulo.

to open up a rich territory between Pirapora and Belém. Though it is possible to go by rail from Rio de Janeiro to Montevideo, most people who travel between the two cities usually go by boat, a trip which requires only half the time. The railways are owned variously by the federal and state governments and by private enterprise.

Santos is connected with the coffee region by the São Paulo Railway (Fig. 252), one of the best-earning railways of the world. In going up to the plateau it rises 2,500 feet in a distance of 6 miles and has 5 inclines, each with an 8 per cent grade. Trains are hauled up the inclines with an endless cable system, of which there is a total of 6 miles. This railway is of such importance

to trade that no expense is spared to keep it in excellent condition.

Good highways are being gradually constructed, and there is considerable motor travel. In 1927 a Frenchman made a trip by automobile from Rio de Janeiro to Lima, which may be indicative of the future.

There are also connections by air with both the United States and Europe. Natal, an important world airline base, is a landing point, especially for European planes that take off from Dakar in Africa.

The Amazon basin has about 30,000 miles of navigable waterways. The average depth of the Amazon is 100 feet for a distance longer than the entire length of the Mississippi. Large steamers can go to Manãos, and smaller ocean steamers to Iquitos; many of the tributaries are navigable by small steamers for 500 to 1,000 miles. The permanent swamps along the river courses hinder the development of the region because they make overland transportation almost impossible. The greater portion of the Amazon region is said to be upland, with a climate that is not so unhealthful as is usually supposed, and with many economic opportunities, if only cheap transportation could be provided.

Foreign commerce. Before 1930 the foreign commerce of Brazil was half as valuable as that of Argentina; recently it has been 60 per cent as valuable. Per capita trade is low because of the self-sufficiency of the country and the low standard of living. Exports are greater than imports and, as in Argentina since 1930, have increased in value relative to imports. In 1935 coffee comprised 50 per cent of the total exports, cotton 15 per cent, and cacao and hides and skins each 4 per cent. These contrast with the exports of Argentina, which were almost entirely of cereal and animal products. With the exception of wheat, the leading imports were the same as for Argentina (Fig. 248b).

The United States ranks first in the foreign trade of Brazil, recently taking 40 per cent of the exports and supplying a quarter of the imports. Our leading exports to Brazil are petroleum

products, machinery, iron and steel, and motor vehicles. Unlike our trade with Argentina, in which exports are usually much greater, our imports from Brazil are normally more than double the exports to her. The German Reich is second, with roughly a fifth of the trade, followed by the United Kingdom and Argentina, the latter sending largely wheat. There is a good basis for exchange between tropical Brazil and temperate Argentina.

Belem, Manãos, and Iquitos are Amazon ports, all being collection centers for the different forest products, although they are not so important now as in the days when Brazil led in rubber

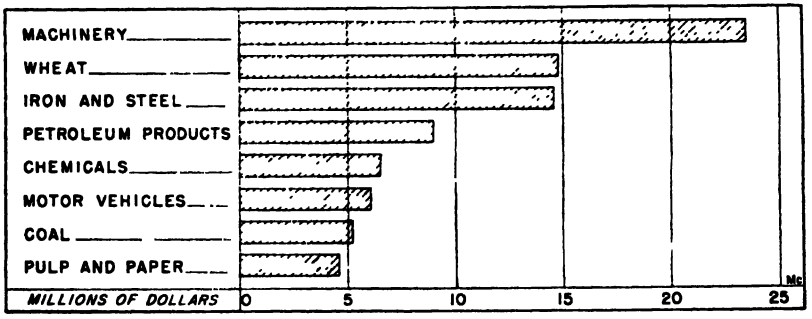


Fig. 253 Principal imports of Brazil in 1935

production. Rio de Janeiro, on a protected bay which is one of the world's best harbors, is a modern city with about 2 million people in its metropolitan area, and it claims to be the cleanest city in the world. The frequent torrential rains are a great aid in keeping the streets of the cities clean.

Santos is the leading exporting city of Brazil and the world's leading coffee exporter. Considerable coffee is also sent through Rio de Janeiro. Santos has 3 miles of wharves and storage space for 5 million bags of coffee—the docks can accommodate 50 ocean steamers at one time. São Salvador is an important coaling station.

A future great region? It would seem that, given time, the region between northern Minas Geraes, or possibly Natal, and Buenos Aires will become one of the world's leading centers of

industry and population. There is great variety of climate and topography, making possible the production of many different agricultural products and the likelihood of finding many mineral resources. The entire area is relatively close to the coast, which, in spite of the difficulty of constructing railways across the escarpment of the plateau, is an important commercial advantage. Although coal is scarce, it may be imported, and there is an immense wealth of favorably located water power. Almost all of the region is suited to white people. The climate is not as changeable and therefore not as stimulating as that of North America or Europe, although it seems to be an invigorating type. More railways will be a great help, and, as has been stated, they are being planned and will gradually be built.

45
THE NORTH-COAST COUNTRIES

THE north-coast countries of South America—Colombia, Venezuela, and British, Dutch, and French Guiana—combined are 30 per cent as large as the United States and have 10 per cent as many people. Colombia contains almost half of the total area and two thirds of the people. Venezuela is four fifths as large as Colombia, and the three Guianas together are a little larger than California. British Guiana contains half of the total area of the three, and two thirds of the people. As a whole the Guianas have a population density of about 3 per square mile; Venezuela has 10 and Colombia has 19. Its reputation as a penal colony and the neglect of development of its resources have caused French Guiana to remain so backward and unpromising that its population has declined seriously during the past decade.

THE GUIANAS

Geographic features. The three Guianas are relatively unimportant colonies of European powers. They have several resources, but the equatorial climate, the large proportion of marshland and jungle, falls in the rivers, and poor commercial location have all retarded their exploitation. The Kaietawe Falls in the Potaro River is one of the highest in the world, having a drop of 829 feet. The shape of South America causes the main routes to miss these countries. Ships go either to Venezuela or Colombia or else past Cape St. Roque to more southern points.

Physically, the three are similar: each has low-lying, hot coastal areas and highland areas. But the highlands, in the southern—

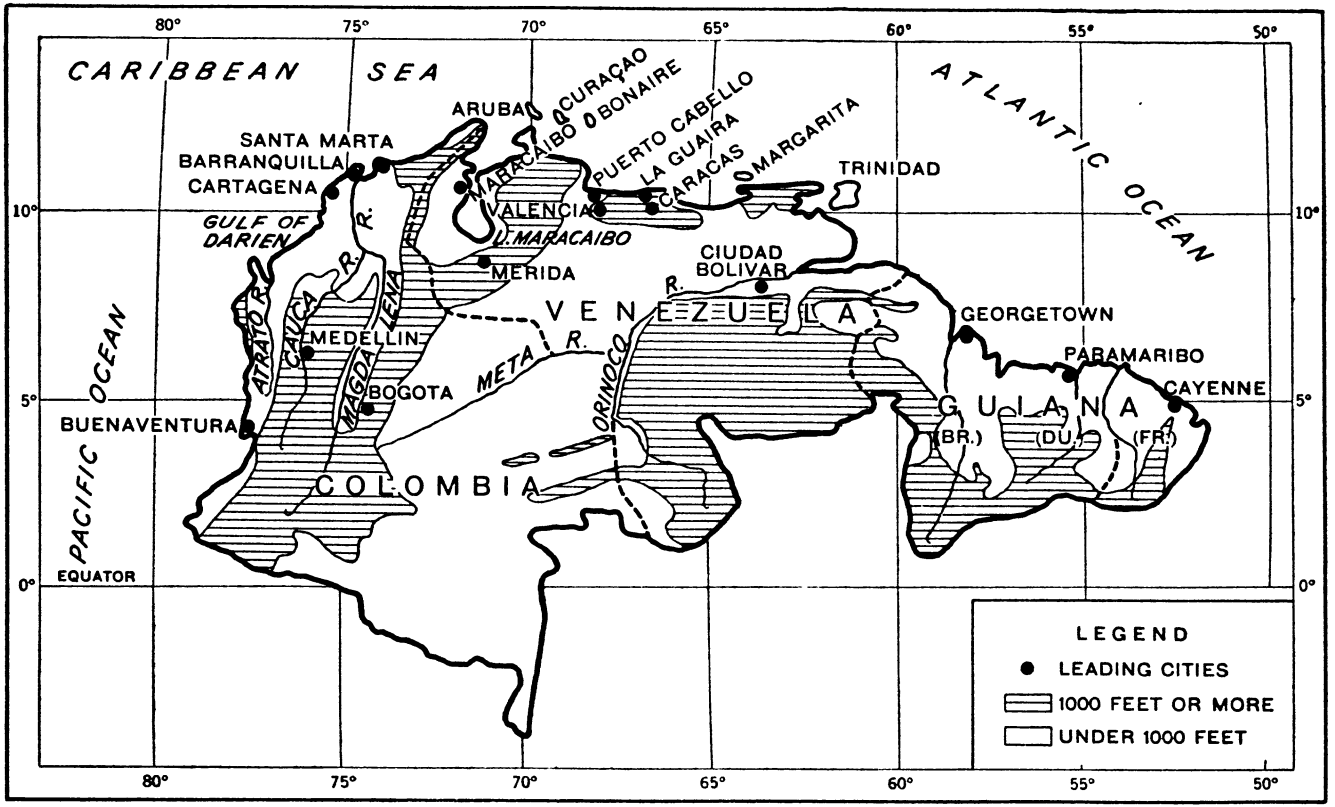


Fig. 254 The north-coast countries of South America.

the most inaccessible—part, are not elevated enough to temper the climate very much.

Natural resources and industries. The Guianas are of industrial significance chiefly for bauxite. There are large deposits along the banks of the McKenzie River in British Guiana and along the Surinam River in Surinam. Exports of bauxite are about equal from each country; those from British Guiana go largely to the Lake St. John district of Canada for smelting; those from Surinam to East St. Louis by way of the Mississippi. Gold is mined by placer methods in all three colonies, and in French Guiana gold mining is the leading industry.

The leading crop in both British Guiana and Surinam is sugar cane, which is grown by Oriental labor on large plantations, chiefly on the flat coastal plains and for a short distance up the river valleys. Much drainage is necessary in the lowlands, for they are flooded not only at high tide but also during the wet season, when the rivers overflow. Rice, grown chiefly along the coast on abandoned sugar lands, is the second-ranking crop of British Guiana. Its production is expanding, and it is thought that this country might become a great rice grower. Coffee ranks next to sugar cane in Surinam. Some of it is grown on the sugar estates. A scarcity of labor has retarded crop production in both colonies, and it is to overcome this deficiency that both the British and Dutch have imported large numbers of Orientals.

In 1935 sugar comprised two thirds of the exports of British Guiana, going largely to Canada; gold 8 per cent and bauxite 6 per cent. Half of the total exports were to Canada and nearly all of the remainder to the United Kingdom. Flour, textiles, and machinery were the leading imports, half of the total being from the mother country. Sugar and bauxite each were roughly 40 per cent of the exports of Surinam, although sugar exports were only 8 per cent of those of British Guiana, and coffee comprised most of the remainder. Imports were similar to those of British Guiana. Except for bauxite the trade is largely with the Netherlands.

VENEZUELA

Inasmuch as the structure, climate, domestic food crops, and animal industries of Venezuela and Colombia are similar to those of Ecuador and Peru, only activities of major industrial and commercial significance will be discussed here.

Venezuela is important in world commerce for the production of petroleum, which far outranks every other industry. Other leading products are coffee, gold, and cacao.

Minerals. Venezuela ranks third in the production of petroleum, with about 9 per cent of the world output. This mineral has been tremendously important in the development of the nation. The government enjoys an excellent credit rating, and the country leads South America in internal improvements, because of the revenues from the petroleum industry. The leading field is the Lake Maracaibo lowland; another is in the east, where recently discovered reserves are now being exploited. Output has grown rapidly from slightly more than 1 million barrels in 1921 to 138 million barrels in 1929 to 187 million barrels in 1937, after a decline to less than 117 million barrels in 1932.

Gold is mined at various places in the Orinoco basin and in the highlands near the Guianas.

Coffee. Venezuela produces about 5 per cent as much coffee as Brazil, and, although the quality is superior to that of Brazilian coffee, it is not equal to that of Colombian coffee. About a third of the exports are sent to the United States to be used for blending. Though large plantations prevail, the industry is not conducted as carefully as in Colombia. The leading centers of production are to the south of Lake Maracaibo, the hinterland of Puerto Cabello, and the highlands near Carácas.

Cacao. The output of cacao in Venezuela is slightly more than half that of Ecuador. The quality, however, is claimed to be the highest in the world. There are about 5,000 plantations located to the south of Lake Maracaibo and in the region near Puerto Cabello.

The Orinoco Basin. The Orinoco basin, a small portion of which is in Colombia, is largely a great grassland or savanna region. Cattle grazing, the only industry of any importance, is limited by natural difficulties and by the lack of good transportation facilities. In the wet season during the summer, when the winds are from the east or southeast, the cattle are forced to go to the higher lands and to the foothills. When the floods subside, a good growth of grass remains; but the dry season, with its northeasterly winds, soon sets in, during which the grass becomes parched and much of the area is little better than desert. At this time cattle are frequently driven through the gaps to the coastal lowland to graze; later they are sold to supply meat for the population in the highlands.

Lack of transportation is the main limitation on greater economic development. Railways and motor roads are both difficult to build, and the operation of motor trucks has not been successful. Oxcarts and pack mules are expensive and almost prohibitive for distances greater than 250 miles, unless the country is level and easy to cross. During the rainy season the steady easterly winds will drive sailing vessels up the river.

The chief trading center is Ciudad Bolivar. Here products are concentrated for export and sent by boat to Port of Spain in Trinidad for transshipment to larger boats, for there is no port at the mouth of the Orinoco.

Foreign commerce. In 1935 petroleum comprised 90 per cent of the exports of Venezuela; coffee was 5 per cent. The leading imports were cotton goods, automotive vehicles, wheat flour, and lumber and manufactures of wood. The total value of exports was about $108,000,000; that of imports, $34,000,000. About 75 per cent of the exports are to near-by Netherland West Indies (Curaçao and Aruba).

Because of a sand bar at the mouth of Lake Maracaibo, none but specially constructed vessels can enter it. Consequently, the Netherland West Indies serve as a transshipping point for goods destined for Maracaibo and have large refineries to prepare the

petroleum from there for market. In spite of the impediments, Maracaibo is the principal port of the country. The United States ranks second in foreign trade, buying 16 per cent of the exports and supplying 45 per cent of the imports. The German Reich contributes 7 per cent of the imports.

Other seaports than Maracaibo are La Guaira, the port for Carácas, and Puerto Cabello, the principal outlet for coffee and cacao. A new port is being developed on the Bay of Turiamo, one of the best harbors of the entire Caribbean region.

COLOMBIA

With the study of Colombia the circuit is closed—it is a west-coast country as well as one facing the Caribbean, where the United States is more directly concerned. Important in world commerce are the production of minerals, particularly petroleum, and recently gold, and of coffee and bananas. The inaccessible plateau of Bogotá, which is the center of population, is important for grain, fruit, and cattle production.

Minerals. Chiefly in the middle part of the Magdalena Valley but also from the Lake Maracaibo region, Colombia has an output of petroleum equal to that of Peru and slightly greater than that of Pennsylvania. The country is third in South America in the output of gold. Its mining industry centers at Medellin and near Bogotá and produces 90 per cent of the world's emeralds from mines operated and guarded closely by the national government. The output of platinum is important from alluvial deposits in the region of the Choco River, but the industry is declining.

Coffee. From Bogotá to Carácas in Venezuela is almost a continuous coffee region. Colombia ranks next to Brazil in output, leading in the production of mild-flavored coffees, and has about 18 per cent as many trees as Brazil. Owing to its mild flavor, Colombian coffee is used much in the United States for blending purposes, and therefore overproduction in Brazil has not injured its market. Rather, the price stabilization measures of Brazil have encouraged expansion in Colombia, where there is much

unused land suited to the crop. The main centers of production are on the slopes of the upper Magdalena and Cauca Valleys. The crop is harvested the year round, and quality is guarded carefully. Production is largely from carefully worked small holdings, the average having less than 9,000 trees and the majority less than 5,000.

Bananas. Bananas are grown under irrigation, largely in the lowlands near Santa Marta. Half of the acreage is owned by the

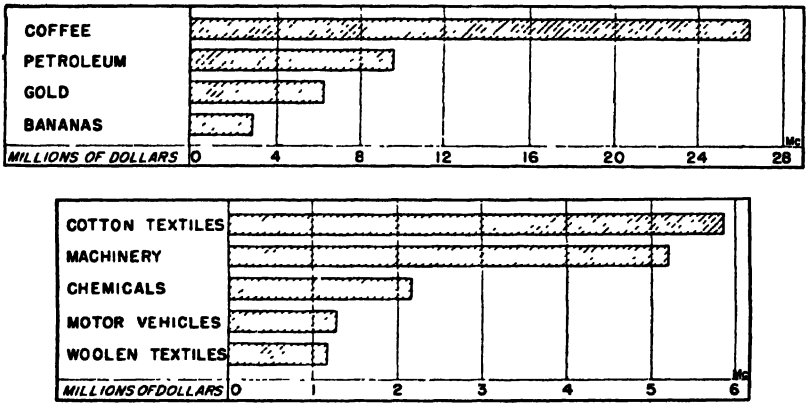


Fig. 255. Principal items in the foreign commerce of Colombia in 1935. (Exports above, imports below.)

United Fruit Company and the remainder by independent growers. One third of the British imports are from Colombia.

Foreign commerce. Leading items in the foreign commerce of Colombia are given in Figure 255. In 1935 exports were about $48,000,000, imports, $35,000,000. As in Venezuela, exports are normally greater than imports, but the two are more evenly balanced in Colombia. Of late the United States has purchased about 60 per cent of the exports and has supplied 40 per cent of the imports; the German Reich has supplied 19 per cent of the imports and the United Kingdom 17 per cent; and 12 per cent of the exports have been sent to Germany.

Barranquilla is the leading seaport. Santa Marta is the banana port, and Buenaventura is the most important Pacific port. The latter is connected by rail with the coffee and mineral centers.

46

THE ISLAND REPUBLICS AND COLONIES

Area and population. The island republics and colonies of the Caribbean Sea, combined, are 91,236 square miles in area and have 12 million people. Cuba contains half of the total area and a quarter of the population. Except in Cuba and Puerto Rico, where whites outnumber blacks, the people are largely Negro. Puerto Rico, Jamaica, and Barbados have dense populations, that of the last being the densest of any agricultural country. Slavery brought the Negroes to these islands, several of which now furnish surplus labor for the industries of the region.

Factors in progress. This region owes its importance and development to its tropical but varied climate and its excellent location and transportation with respect to the great manufacturing regions of the middle latitudes. The climate is tropical, but with such variations in rainfall, temperature, elevation, and soil that a great variety of products can be grown. Nearness to markets is important for products of a perishable nature; other products whose markets may not be so near are still profitably grown because of the cheap ocean transportation. Furthermore, the greater part is under the control of the United States and Great Britain, which gives marketing advantages not always possessed by the independent countries. The fact that there are large foreign investments in these lands helps to influence the direction of the trade; some of the trade, for historical reasons, still follows the same channels in which it established itself when the region contained the leading colonial possessions of some of the European powers.

The strategic value of this region to the United States should be kept in mind.

Geographic features. The outstanding physical features of the West Indies are the mountains or highlands extending through the middle of nearly all parts except the Bahamas and flanked by plains on either side. The mountainous areas are largely volcanic. Another feature is the great area of coral formations, which, because of the warm waters of the Gulf Stream, extend farther north than is usual. Beginning in the peninsula of Yuca-

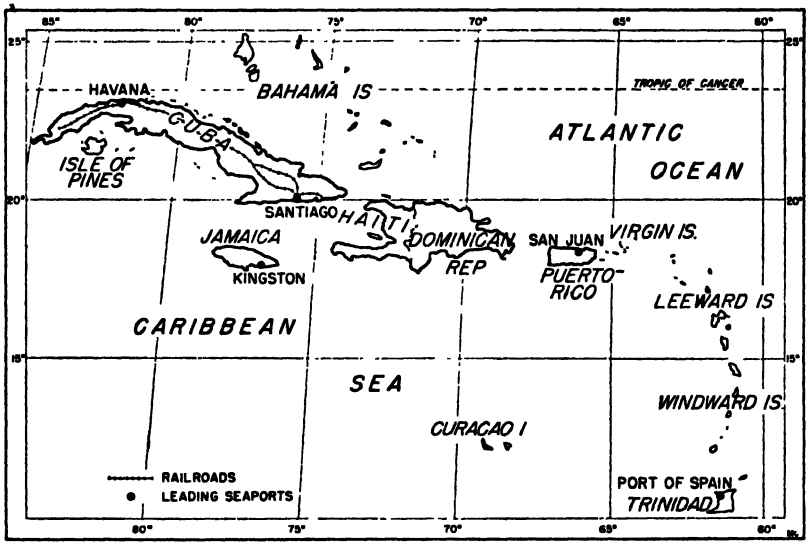


Fig. 256. Island republics and colonies of the West Indies.

tan, the entire region is flanked by coral limestone on the Gulf and Atlantic sides. This combination of limestone and volcanic material produces fertile soils.

The Lesser Antilles extend in an arc from Puerto Rico almost to the mouth of Lake Maracaibo. The northern ones have been called the Windward Islands; the southern ones the Leeward Islands. Next to the Atlantic there are two rows of islands, the outer being coral and the inner volcanic. In many islands both types of formation are found, as in Guadeloupe, whose eastern

half is limestone and western half volcanic. Trinidad and Tobago are separated sections of the highlands of Venezuela.

Climate. The trade winds prevail throughout these islands. Temperatures are high, without much seasonal range, although cold winter winds from the continental high-pressure area of North America often reach Cuba and Jamaica. The prevailing wind is from a northeasterly or an easterly direction, depending upon the latitude and the season of the year. It thus blows against the mountain ranges, causing a wet and an arid side on most of the islands. The main exceptions are Cuba, whose elevation is

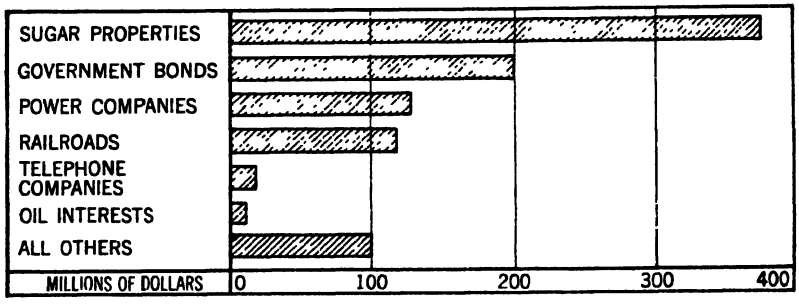


Fig. 257 Estimated American investments in Cuba in 1933 (Source of data, *Literary Digest*, August 26, 1933.)

sufficient but not too high to obtain rainfall throughout, and the Bahamas, which are desert because of their low elevation, since there is nothing to cool the winds as they blow across. Some convection rain occurs, and the small amount that the leeward locations obtain comes chiefly in this form.

The best islands for human beings to live in are level ones built of coral. Their level nature permits the trade winds to sweep them, and the coral gives excellent drainage. This, along with their excellent winter climate, is making some of them winter and health resorts. The tourist industry is important in the Bahamas. Barbados serves as a resort for neighboring islands and countries and attracts people from colder lands.

Another characteristic of the climate of the Caribbean is the severe hurricanes, usually destructive, but sometimes beneficial

because the accompanying rains revive crops and replenish supplies of storage water. Their effects are often such as to change the entire agriculture or crop system of an island or section. The more mountainous islands are not usually affected as much as the level ones, because the valleys afford protection.

Minerals. The only important minerals are iron ore, manganese, and chromite ore in the eastern end of Cuba, and petroleum and asphalt from a lake in Trinidad which is the remains of an old oil field. Trinidad has been an important producer of petroleum for many years and seems to have large reserves. The reserves of iron ore in Cuba are estimated at one billion tons. The ore, found near the surface, is cheap to mine. About the only use for it and the other metals occurring there will be for export to the United States and Europe. Cuba needs steel products but lacks fuel with which to smelt the ore. The deposits are owned by American capital.

Fisheries. The most important fishing industry in the Caribbean is sponge fishing near Cuba and in the Bahamas, where it employs 5,000 people. Nassau is one of the greatest sponge markets in the world. Turtles and turtle eggs are other products from the Bahamas, and turtles are caught for tortoise shell around Jamaica. The catching of food fish is important in many of the islands, notably Barbados.

CROPS OF THE WEST INDIES

Sugar cane. Since colonial days the leading crop of the West Indies has been sugar cane. Rum, molasses, and alcohol have all been produced as by-products. In early days rum was important, but more recently the output of alcohol has been increasing. On most of the islands the leading sugar lands are the level, porous areas on the leeward or dry side. Since Cuba became the world's leading exporter of cane sugar, largely on account of the rise of the great American market, the industry has declined in many of the older areas, where now it must be conducted near the coast to keep freight rates down. The abolition of slavery and the

rise of beet sugar were also obstacles. In many of the smaller islands, however, such as Barbados, St. Kitts, and Antigua, sugar is still the leading and in some cases about the only cash crop.

Cuban sugar-cane industry. Because of Cuba's high rank as a producer of sugar cane, the methods of production will be described. Both red clay and black soils are used, the former being most extensive and considered best for the crop, although well-drained black soils produce heavier crops. Some of the deep red



United Fruit Co.

Fig. 258. Cultivating sugar cane on a plantation in Cuba.

soils have been cultivated for a century without fertilization. About 60 per cent of the land is flat or rolling—ideal conditions for extensive methods of production and the building of large *centrals* (factories for crushing the juice from the stalks) with a network of tramlines. Drought, irregular rainfall, and hurricanes are adverse factors. Extensive methods have prevailed because of the great amount of available land. Some of the better plantations recently have been introducing improved methods.

Planting may be done either in the spring before the rains or after they are over in the fall. Replanting is done at intervals of 5 or 10 years. In 15 to 18 months after planting, the crop is ready

to cut. At this stage the leaves dry up, and there is great danger of fire.

The harvest period is determined more by the season, however, than by the condition of the crop. From December to June is the usual period. Much of the crop, especially that grown by small-scale growers, must be taken to the *centrals* in large oxcarts. The

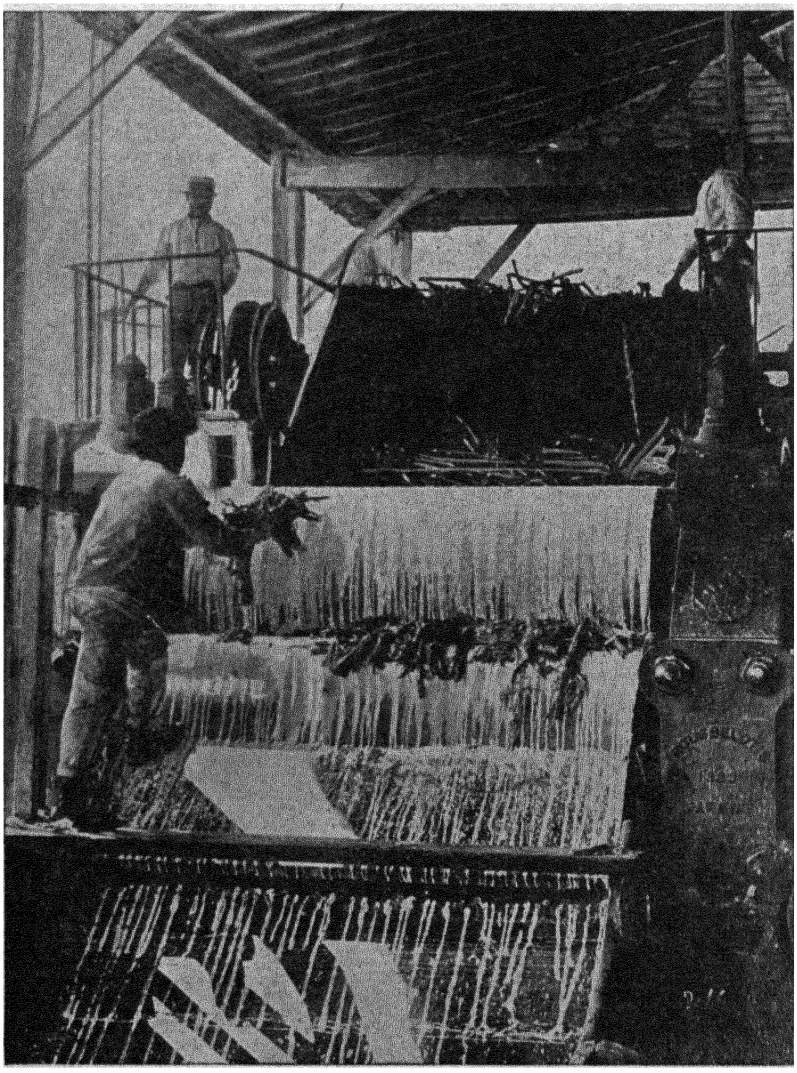


Fig. 259. Crushing sugar cane in a *central*.

ground must become firm after the rainy season is over before the cane can be moved. Sometimes cane which matures late in the winter must be left standing until the next winter before it can be harvested. The average production of cane is about 20 tons per acre; this amount returns about 2 tons of sugar.

There are three types of growers: the large estates, the small independent growers, and the *colonos*, who are tenants of the large companies and grow the crop under contract. Some of the large companies grow most of their own cane; but for the entire industry, more than half is produced by the small growers. They must, however, haul their cane to the large *centrals* for crushing. The average size of the farm of a tenant is about 66 acres. It is these small growers who depend upon oxcarts to haul the cane, the large estates having tramlines for the purpose. Recently the plantations and the *centrals* have been increasing in size. During the harvest period about 80,000 workers migrate to Cuba, largely from neighboring islands.

In 1937 there were 73 *centrals* operating in the island. Oriente, where the industry is quite new and where some of the largest plantations are located, is the leading province. Sugar is exported through about 20 ports, most of them on the north side of the island.

Coffee. Coffee of desirable aroma is grown in a majority of the islands, but the quantity is small and the methods of harvesting it and preparing it for market are poor. The growing of coffee is a cottage industry carried on by the native mountaineers, who, in many cases, have been driven inland by the encroachment of the sugar plantations, which are to a large extent controlled by foreigners. Haiti, growing about one fifth as much as Colombia, contributes about 60 per cent of the total; it makes up the leading export of that republic. Much of the production is wild coffee. Puerto Rico, the Dominican Republic, and Jamaica follow Haiti. Puerto Rico grows twice as much as the other two. The Blue Mountain coffee of Jamaica is the highest-priced coffee

in the world. Its quality is the result of a cool climate with alternating periods of rain and sunshine the year round. A large part of the coffee from this area is sold in France.

Cacao. Before 1918 the Caribbean region was the chief source of cacao for the United States. The acreage is still expanding in the sheltered valleys that are out of the main hurricane zone. The Dominican Republic and Trinidad are the leading growers; the region ranks third, following the Guinea region and Brazil. In contrast with sugar cane, which is usually grown on the drier, sunny side of the islands, cacao is grown chiefly in the hot, moist, protected valleys on the opposite side.

Coconuts. Coconuts, both wild and cultivated, are grown widely, and fresh coconuts, copra, coconut oil, and *coir* (the fiber from the husks) all are exported. The region leads the world in exporting fresh coconuts. Only the larger ones are exported; the others are made into copra and oil. Coir is made into brushes, mats, and mattresses.

Coconut trees require a light, well-drained soil and much heat and moisture. For the most part they grow on sandy beaches, chiefly in locations that are too dry and too windy for cacao. Jamaica and Trinidad are the leading producers, the former having large coconut estates along the north coast near the sea.

Fruits and vegetables. The growing of fruits and winter vegetables for the expanding markets of the United States, Canada, and Europe has been developing in several of the islands. This has come about because some of the islands, such as Cuba, are trying to diversify agriculture in order to lessen dependence on one or a few crops; others, such as Montserrat, where the lime plantations were injured by the hurricane of 1928, are changing to crops that are not easily damaged by hurricanes. The production of fruits and vegetables now ranks third among the industries of Cuba.

Jamaica, Trinidad, and the Isle of Pines, whose land is owned largely by Americans, are all expanding their acreage of grape-

fruit. That of the Isle of Pines is ready for market before the Florida crop, while that from Jamaica may be sent to the European and British markets before grapefruit from the Union of South Africa and the United States are ready.

Oranges are grown and used locally but are not exported greatly except from Puerto Rico to the United States. Other sections have difficulty in competing with the crops of the United States and Spain.

Pineapples are grown in many parts of the islands. Cuba leads, but Puerto Rico, Haiti, and some of the Bahamas are important. The majority of the fresh pineapples on our markets are from Cuba. Pineapples and other fruits and vegetables are canned. Nassau has a pineapple cannery, and Cuba has an increasing production of several kinds of canned and preserved fruits. In Puerto Rico fruits and vegetables are both canned. Pineapples are grown in the drier parts of the region, where light, almost sandy, soils are found.

Jamaica and Cuba both have an important banana-growing industry; the former, where the industry is encouraged by a cooperative producers' association, now leads the world in the production of the crop.

The island of Dominica produces the major share of the world's commercial supply of limes.

The leading winter vegetable is fresh tomatoes. Montserrat sends both tomatoes and onions to Canada. Eggplant and peppers follow tomatoes in Cuba, and many others are exported to the United States in small quantities. The vegetable and fruit district of Puerto Rico extends westward from San Juan for about 60 miles along the coast. The fruit is grown chiefly in small valleys and on the low hills. Pineapples mature here a bit earlier than in Cuba.

Other crops. There are several products which, though small in quantity, are an important source of income to the people who produce them, and the West Indies are about the only source of some of them.

Cuba and Puerto Rico grow tobaccos which are used largely for cigars. The more famous is that of Cuba, its tobacco leading the world in the excellence of its flavor and aroma. Tobacco is grown throughout the island, but the best qualities come from certain restricted districts, a part of the crop being grown under shade. The major portion, however, is grown in the open. Most famous is the Vuelta Abajo district of about 25 square miles on the south side of the mountains in Pinar del Rio Province in the western end of the island. Tobacco from this district has sold for as much as 20 dollars a pound. Attempts to duplicate this type of tobacco in other parts of the world have never been entirely successful. Although the reason for the quality has never been determined, some think that it may be caused by the limestone soil. The crop is air cured and carefully fermented. Planting takes place about the middle of October, and in three months the crop is ready to be harvested.

The outer edges of the Vuelta Abajo district produce a fair grade of tobacco, and the eastern end of Pinar del Rio and the western end of the adjacent province produce a type that ranks second in quality. There are several other lesser districts. Puerto Rico produces good cigar leaf, which, however, does not compare with the best Cuban leaf in quality. Puerto Rican leaf is exported largely to the United States.

Jamaica produces nearly the entire world supply of pimento, or allspice, and also a large amount of ginger, which ranks second in use among the spices, black pepper being first. Pimento is the small dried berry of a native tree that grows in the cattle pastures on the drier limestone areas near the center of the island. A coöperative marketing association was formed for this product in 1930. Ginger, which grows widely in the mountainous parts, is the root of a reed-like cultivated plant. Requiring almost a year to mature, it is dried in the sun upon harvesting. Grenada is important for mace and nutmegs. Mace is the covering of a nut whose kernel is nutmeg.

Rice, grown in many places, is such an important article of diet

among the natives that some must also be imported to satisfy the demand. The United States ships rice to Puerto Rico. In nearly every case the rice of the Caribbean is grown by East Indians who have migrated or have been brought into the region by the British.

Nearly all of the arrowroot of commerce is from St. Vincent. It is the starch from the root of a plant and is used in cooking in the same manner as cornstarch. A growers' and exporters' association is trying to expand its market in the British Isles.

A few textile fibers are grown, the West Indies being the original home of sea-island cotton and about the only place that grows the crop, since the boll weevil has made its production in the United States almost impossible. It is the leading crop in St. Vincent; St. Kitts is said to grow the best sea-island cotton of any place in the world. Haiti and Puerto Rico grow other varieties. Sisal is grown in many of the drier sections, and, were it necessary, the production could be greatly increased.

The Virgin Islands are noted for bay rum. Bay oil is obtained by distillation from the leaves of the bay tree, which grows chiefly on St. John. St. Croix produces rum from its sugar industry, and the two products are made into bay rum on St. Thomas. One gallon of bay oil is mixed with about 100 gallons of rum or alcohol.

FOREIGN COMMERCE

In 1935 the foreign commerce of the West Indies was roughly $350,000,000, exports being somewhat greater than imports (Fig. 260). The exports were about equal in value to those of Netherland India, but the imports were 50 per cent greater than those of Netherland India. The sugar industry, with raw and refined sugar and molasses and rum, supplies the bulk of the exports, normally about 75 per cent of those of Cuba. Other important exports are tobacco, fruits, cacao, coffee, vegetables, spices, and minerals. The principal imports are textiles, iron and steel, machinery, flour, meats, petroleum products, and paper. Slightly more than half of the foreign trade is with the United States, the proportion of exports to this country being a little greater than

the proportion of imports supplied. Free trade with the United States is important for the products of Puerto Rico, 95 per cent of the trade being with us. The distribution of the foreign com-

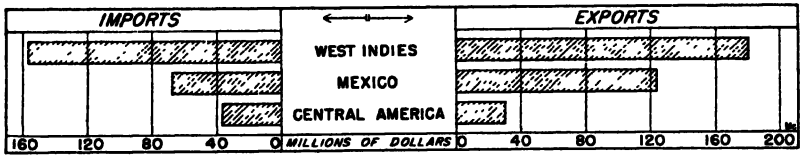


Fig. 260. Volume of foreign commerce of the West Indies, Mexico, and Central America in 1935.

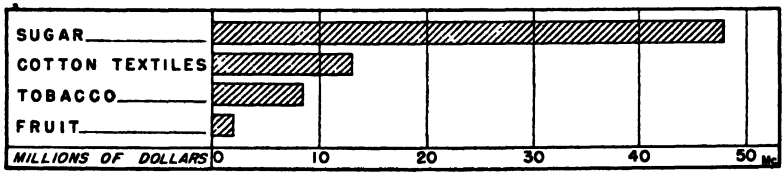


Fig. 261. Principal exports of Puerto Rico to the United States in 1935.

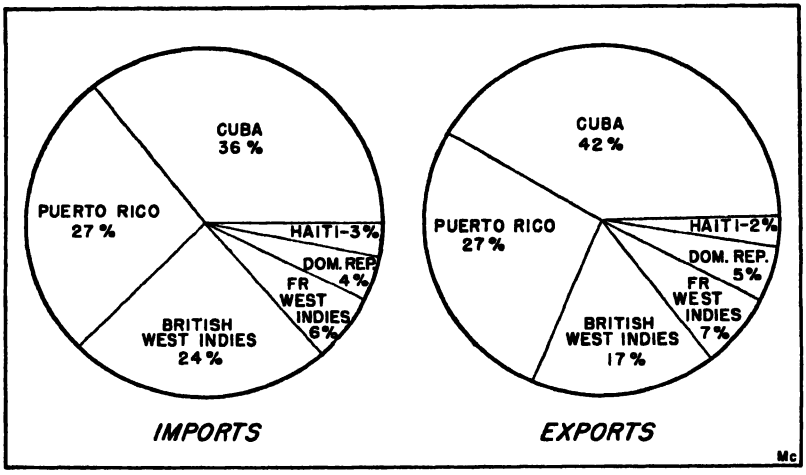


Fig. 262. Distribution of their total foreign commerce among the island republics and colonies of the West Indies in 1935.

merce among the various divisions of the region is given in Figure 262.

Several of the seaports have already been mentioned. In the days of the sailing vessel, Barbados, being farther east than the

other islands, was the leading point of call, but when the steamship came into use, Jamaica, among the British possessions, became more important because of its central location. Location on the Panama Canal route now increases its value still more. Kingston, on a fine harbor, is an entrepôt and a fueling station.

The interest of the United States in the Virgin Islands depends on the harbor of St. Thomas on the island by the same name, which is used as a naval base. It was formerly a fueling station, being located so as to control one of the deep passages between the islands leading to Europe; but it has declined in this respect with the rise of oil-burning ships. Cuba has several important seaports and many excellent bottle-neck harbors. The United States maintains a naval base at Guantanamo.

THE BERMUDAS

The Bermudas are similar in features and products to the West Indies and are of considerable strategic value to the British, being a half-way station between the British Isles and the Caribbean. They are a naval base and serve as headquarters for maneuvers of the British fleet in the Atlantic. Ireland Island harbor, an atoll harbor, is one of the best in the world and could accommodate the fleets of all of the nations at one time.

These islands supply early winter vegetables, which mature earlier there than in Florida, and Easter lily bulbs to the markets of the United States. They also provide a winter resort for Americans.

47
THE CENTRAL AMERICAN COUNTRIES

THE six republics and one British colony of Central America (Fig. 263) have a combined area of 217,389 square miles and contain about 7 million people. Nicaragua, Guatemala, and Honduras each contain slightly more than one fifth of the total area. Guatemala has a third and El Salvador a quarter of the population. Density ranges from 6 persons per square mile in British Honduras to 121 in El Salvador.

There is a mixture of races and crossbreeds, and nowhere, except in Costa Rica, do whites predominate. The remaining countries have a preponderance of mestizos. There are many Negroes in the lowlands who have migrated from the West Indies to work on the plantations. Honduras, with more Negroes than the other countries, recently passed a law prohibiting their further immigration.

A small number of whites ruling over large numbers of Indians, Negroes, and mestizos is not conducive to stable political conditions. This condition, the presence of the several races, the general low economic and social conditions and illiteracy of the people, and the isolation of many parts of the region have combined to cause much friction and unrest. It is noteworthy that Costa Rica, where nearly the entire population is white and where practically every head of a family is a small landholder, has had the most stable political conditions of any of these countries.

Geographic features. Central America is physically and climatically similar to the West Indies. There is a central highland, volcanic throughout in the Pacific area but not on the Atlantic

slope, extending at right angles to the northeast trades, and with a coastal plain on either side.

The location of this narrow body of land between two oceans and between two large continents is strategically important. There are two low routes across it, one occupied by the Panama Canal, the other the route of the proposed canal through Nicaragua, and a low route at either end—on the north the Tehuantepec lowland of Mexico and on the south the Atrato River, the

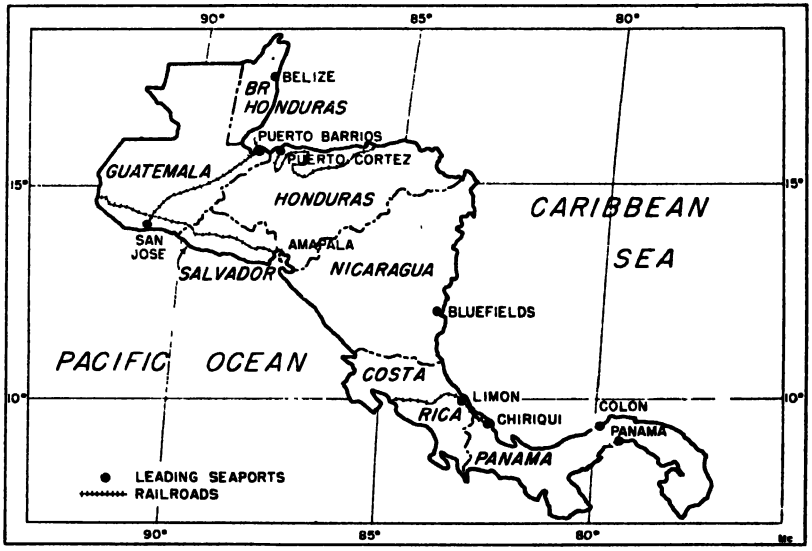


Fig. 263. Central America

route of another proposed canal. The United States government has an agreement with Nicaragua concerning the route there and concerning the building of naval bases on Corn Island and in the Gulf of Fonseca.

Forests. Seventy-five per cent of Central America is forested; in the lowlands grow tropical hardwoods, in the uplands oak and pine. The exploitation of tropical species of trees, which grow mainly in scattered stands, is costly. There may be, for example, only one or two mahogany trees per acre. After a cutter sights a tree, he must cut his way to it through a dense undergrowth; and

after it is cut, he must contrive to get it to a stream for transportation. Mahogany, once abundant but now largely depleted, is cut principally in Guatemala, Honduras, and British Honduras. Guatemala and British Honduras both have chicle forests, and the latter logwood. Nearly all of the world's Peruvian balsam, a medicinal product, is from a species of tree in Salvador. Coconuts grow wild along the shores of all of these countries.

Minerals. The structure of these countries has been conducive to mineralization, particularly concentration of gold and silver ores in veins through crystalline rocks. Deposits are known in many places and have been worked for years, but exploitation is limited by the lack of transportation. Honduras, Nicaragua, and Costa Rica mine the ores of silver and gold, and Guatemala those of gold and lead and mica. There are also large deposits of high-grade chromite ore in southeastern Guatemala.

Water power. Central America has well-distributed potential resources of water power about equal to those of Sweden; however, cheap power is not possible because seasonal rainfall would necessitate the construction of huge reservoirs. Only a little more than 100,000 horsepower have been developed, and almost half of this is in Panama, where it is consumed in operating the canal. Thought is being given to further development, and were more power generated, it might serve small-scale factories to supply local markets. In 1928 Costa Rica passed a law nationalizing all electric power.

Bananas. The banana is a starch food, like the potato, and is as productive in food per acre. It contains all of the elements required by the human body, but the proportions of protein and fat are too small to make it a balanced diet. Eaten with milk or meats, it provides a complete diet. With the exception of grapes, it is the richest of fruits in caloric value and ranks with lettuce and peas as a source of vitamin A.

The plant, a watery annual growing from 12 to 25 feet high and to 15 inches or more in diameter, grows but one bunch of bananas. Plantations are started by setting out roots; but after the plants

start bearing, new shoots develop from the suckers that come up around the base of the old trees, which are cut down after the fruit is harvested. Ten or eleven months are required for a plant to blossom, and three or four months more for the fruit to develop. Bananas, even when used locally, are always cut green. If permitted to ripen on the tree, they become insipid and the skin bursts, permitting insects to attack them.



Brown Brothers.

Fig. 264. View of a banana plantation.

To be grown most successfully, the banana requires heavy rainfall, uniform, high temperatures, a fertile soil, and protection from destructive windstorms. The plantations usually are located on alluvial fans or on the flood plains along the lower courses of the rivers. Fine sandy loams with good water and air drainage are best. The banana, like sugar cane, is very hard on the soil.

The marketing of bananas is the most exacting part of their production. After being cut, they start to ripen, and temperatures that are either too high or too low will cause rapid deterioration. Careful attention and inspection are necessary all along the

route after they are once cut. Cutting, transporting to the seaports, and shipping must be so coördinated as to permit continuous operations and the loss of as little time as possible in getting the fruit into the hands of the consumer. At the other end of the marketing route, the jobbers, through whom the bananas are marketed, must have a well-organized system for taking them from the ships and sending them over the country, protecting them all the while.

Honduras is first in Central America in bananas, the industry being dominant along the north coast. Costa Rica led at one

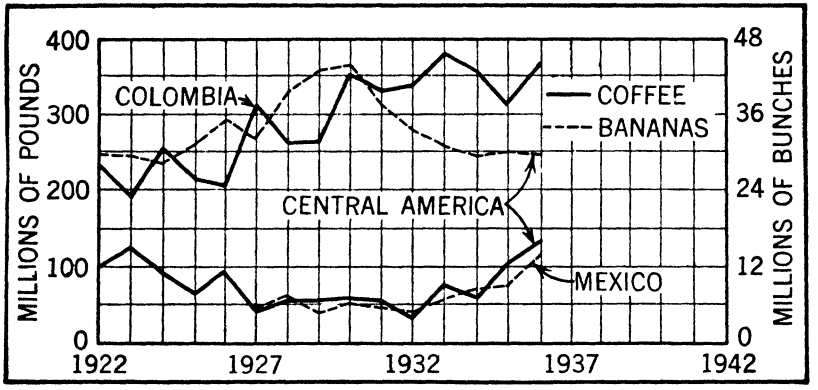


Fig. 265. The trends of the imports of coffee and bananas into the United States from selected countries for year ending June 30.

time but has dropped far behind because of the banana wilt, a soil disease, and high export taxes. The banana wilt has become a serious cause of loss in Honduras also during the past several years. Bananas are the leading crop of Panama and of eastern Nicaragua and are becoming an important crop in the region of Lake Izabal in Guatemala.

Coffee. The highlands from southern Mexico to Panama are almost a continuous coffee region. The climate and the volcanic soil make it an ideal region for coffee—a fortunate circumstance, because there is hardly any other crop in general demand which the natives could grow and export profitably. The people of these countries live in the highlands, and, since inland transpor-

tation is poor, a durable product of considerable value in small bulk is necessary. Otherwise there would be nothing to exchange for products from the outside world. Most plantation products provide revenues for the governments, but they are of little aid to the natives because they are grown largely by foreign corporations.

Guatemala, where half or more of the coffee plantations are controlled by Germans, produces from 40 to 45 per cent of the total crop of the region and usually has an output about half that of Colombia. One starts a plantation by obtaining a concession of land from the government. Indians on the land become vassals of the concessionaire. Salvador, Costa Rica, and Nicaragua are important growers, and the acreage has recently expanded considerably in Panama and Honduras. In all of these countries small-scale holdings prevail. In Costa Rica the head of almost every family has a small coffee orchard. Many of the people live in the cities and leave the orchard under the care of hired laborers except at harvest time, when the whole family is needed to do the work. In El Salvador the crop is so important to the welfare of the country that a recent law has placed the industry under the control of a joint committee of the government and the growers. In all of these countries the government has recently been encouraging coffee growing.

Most of the Central American coffees are of ordinary quality, but pea-berry coffee from Costa Rica and the Vera Pas and Coban varieties of Guatemala are of superior quality. Europe, whose people have long had a taste for these coffees, has always been the leading market, but since 1920 the market in the United States has grown, because of the extensive use of Central American coffee in preparing blends. Our imports now average almost double what they did a decade ago.

Other crops. Corn, beans, and rice are the leading food crops; cacao, coconuts, sugar cane, tobacco, henequen, and cotton are other money crops. Cacao is grown much in Costa Rica on the

abandoned banana plantations. Though coconuts are grown widely, the leading section comprises only a distance of 60 miles in Honduras, between the Ulua and the Cuero Rivers. Sugar cane is important in irrigated valleys along the Pacific and on the eastern plain. Tobacco, for domestic consumption, is widespread, and there is a small export of manufactured tobacco products from some countries. Cotton production is in the experimental stage. The governments of these countries have been encouraging the introduction of new and improved crops and also better animals. The United Fruit Company maintains experiment stations in several places to encourage crop diversification.

Animal industries. These countries have animal industries, chiefly the grazing of cattle; there is an exchange of products among some of them, and hides are exported from others. In a belt along the west coast there is sufficient rainfall to cause a heavy growth of tall, coarse grass. This grass does not make the best feed for animals but is good enough to support a large cattle industry. Greater markets would likely cause grazing to increase, although the *garapata* (numerous kinds of ticks which infest the grasslands) are a serious menace. Panama has a considerable acreage of potential cattle-grazing lands. Costa Rica has a cheese-making industry and Salvador a swine industry.

Transportation. Local transportation in Central America is largely by human carrier, muleback, and oxcart over extremely poor roads. Heavy expenditures for surfaced highways are being made throughout the region, and it should not be long before all of the countries are connected with Mexico and the United States by automobile roads. This should attract tourist traffic from the United States at all seasons.

The total railway mileage, nearly all narrow gauge, is a little less than 3,000, being about equal to that of Idaho. Nicaragua, the largest of the countries, and Panama are especially lacking in railways, and there are none in the interior of Honduras. The Atlantic and the Pacific have been connected by rail across all of

the countries, except Honduras and Nicaragua (Fig. 263), and the lines of some of the countries are interconnected, that of Guatemala connecting with those of El Salvador and of Mexico. Some of the lines are owned by the government, but most of the mileage is owned privately. The United Fruit Company owns 90 per cent of the 900 miles of Honduras railways built to develop the banana industry; it also owns mileage in some of the other coun-



Paul E. Parades.

Fig. 266. Indians carrying pottery and firewood to market near Tegucigalpa, Honduras. Note the volcanic peak in background.

tries. In Guatemala an American company owns the 700 miles of line, but it is subsidized by the government.

All of the important cities are connected with each other and with the outside world by air lines, over which a wide variety of goods are transported. Tegucigalpa is the leading center for air lines in Central America.

Foreign commerce. The principal exports of Central America are evident from the preceding discussion. The leading imports are iron and steel, machinery, textiles, petroleum products, chemicals, flour, tobacco, and meats. Recently about 45 per cent of the total trade has been with the United States, imports and exports being equally divided. In 1935 bananas and coffee comprised

85 per cent of the exports to the United States, the coffee being about two thirds as high in value as the bananas; iron and steel made up 25 per cent of our exports to those countries. Honduras, Nicaragua, and Panama trade relatively more with the United States than do the remaining countries. Much of the goods going to Panama is redistributed to other places. The United Kingdom and the German Reich usually are important in Central American trade, but recent economic difficulties in the German Reich have caused a marked decline.

Much Caribbean commerce is carried in ships of the United Fruit Company. Bananas require special types of ships, which can haul other products and passengers if the trade is properly organized. This adds to the financial stability of the company and is an economy because it provides a more complete use of that company's ships and makes it unnecessary for other shipping companies to enter the field.

There are many seaports in these countries, but a few handle the bulk of the trade. Puerto Barrios in Guatemala is the leading port of Central America. Other leading Atlantic ports in their respective countries are Belize, British Honduras; Puerto Cortez and Tela, Honduras; Bluefields, Nicaragua; and Port Limon, Costa Rica. Belize handles much traffic for Mexico and Guatemala. Puerto Armuelles serves the growing banana industry of Panama. At the Canal Zone, Cristobal and Balboa handle the international traffic destined for Colon and Panama City, while Bocas del Toro cares for the provincial trade. Merchandise for Panama City coming in at the eastern canal ports must take the Panama Railway because the canal is not equipped to care for such traffic. On the Pacific, lighters must be used in the ports. La Unión is the principal port of El Salvador; El Corinto and San Juan del Sur handle the bulk of the trade of Nicaragua. Amapala is the Pacific port of Honduras and San José of Guatemala.

Summary. Central America will continue to be of importance to the outside world because of the products which the fertile

volcanic highlands and the alluvial lowlands will grow. There are deposits of minerals and forest products, but the former are neither abundant nor rich; the latter have been largely worked out. The remaining supplies are of poorer quality and in more inaccessible locations. Though bananas and coffee now provide the bulk of the exports, other exporting industries might be established. These must wait for more stable political conditions and control of the government by those interested in educating and improving the lot of the masses, as well as a careful study of the American market and its particular needs. Nearness and need for the products, investments of American capital, domination of the foreign trade by American shipping companies, and strategic considerations make the United States an important influence in the commerce of the region.

48
MEXICO

Area and population. Mexico, with 760,290 square miles of territory and about 19 million people, is one fourth as large as the United States and has one seventh as many people. One third of the population is urban, and 7 per cent live in Mexico City. Mestizos comprise 55 per cent of the population, Indians 28 per cent, and whites most of the remainder.

Geographic features. Mexico consists mainly of an interior plateau flanked on both sides by high mountains, which in turn are bordered by narrow coastal plains. Such an arrangement of topographic features creates a serious transportation problem. The more elevated, more moist, narrower southern end of the interior plateau is the best part of the country. Though only one sixth of the total area, it contains most of the people. It is a great depression which has been gradually filled with alluvial, lacustrine, and volcanic materials. The resulting fertile soil and the favorable climate make it possible for this region to support a large population. The northern part of the interior plateau is a series of semiarid basins, the line of demarcation between the two sections being where crops will not grow without irrigation. This dry region, fit for little but grazing, is the home of the large cattle ranches, or *haciendas,* and, incidentally, of many of the revolutions of Mexico. Some rivers from the mountains to the west flow across it, but there is not adequate water for widespread irrigation.

Both the mountain ranges which enclose the plateau are extensions of mountain chains of the United States. They converge in a high, dissected volcanic range north of the Tehuantepec low-

land. The Western Sierra Madre Range is almost impenetrable, but the Eastern Sierra Madre Range has several passes leading to the coast, several fertile agricultural valleys, and water power at the southern end. Both ranges have forests on their slopes; furthermore, the western one is heavily mineralized and has considerable water for irrigation on both slopes. The short range on the south has minerals and water power, but transportation is difficult and many parts are isolated.

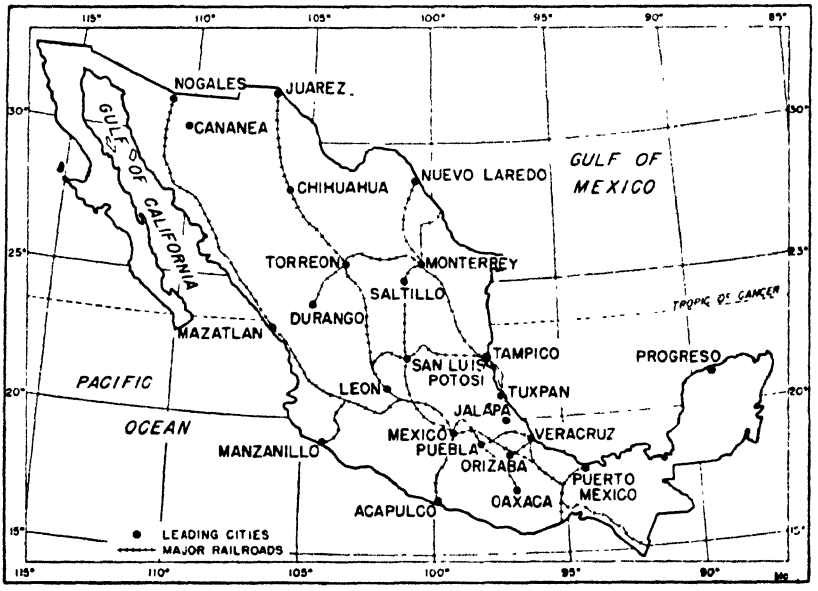


Fig. 267. Mexico.

Much of the coastal plain on the west and the peninsula of Lower California are desert, the northern section of the former being called the Sonoran Desert. The northern section of the Gulf plain and northern Yucatan are dry, though not desert; around the bend of the Bay of Campeche and the Tehuantepec lowland are rainy tropical sections. The Tehuantepec lowland is a route of some strategic value. Before the building of the Panama Canal, much interoceanic traffic was hauled by the railway which traverses this lowland, and it still hauls a large amount.

Climate. Much of Mexico is dry because it is in a position where it receives but little ocean influence because of topography or latitude. The only parts receiving heavy rainfall are the lowlands and the slopes south and west of the Bay of Campeche. The southern part of the plateau, whose mild temperatures prevent rapid evaporation, has light but well-distributed summer rainfall. In summer rising temperatures in the plateau cause it to become a low-pressure area toward which moist winds from both the Gulf and the Pacific blow.

More marked in Mexico, but extending also through Central America and northern South America, are three temperature belts, namely, the hot lands, the temperate lands, and the cool lands. The first includes the coastal plains and the slopes to an elevation of 3,000 feet. Dense tropical forests abound where rainfall is heavy. On the plains such crops as bananas, sugar cane, and cacao may be grown, and on the slopes tobacco, corn, and coffee, the latter principally at the higher altitudes. The temperate lands are between 3,000 and 7,000 feet and include most of the plateau. The climate is always springlike. Where rainfall is sufficient, wheat, corn, beans, fruits, and other middle-latitude crops may be grown. The cool lands, those above 7,000 feet, have coniferous forests and grazing lands.

Forests. Various references have already been made to the forests, now controlled by the government, which cover about 10 per cent of the total area of the country. About half of the forest acreage contains valuable supplies of both tropical and temperate-region species. Those of the uplands are important as a source of lumber and of timber for a domestic paper-manufacturing industry. Products of the tropical forests are mahogany, cedar, logwood and other dyewoods, medicinal plants, rubber, and chicle, Mexico leading the world in the production of the last. Villa Hermosa is a rubber center. It is thought that rubber production could be expanded considerably with the proper organization of the industry.

Chicle. Chicle is an elastic gum obtained by boiling down the milky liquid taken from the inner bark of the sapotillo tree, which grows in Mexico and parts of the Caribbean region. The tree also has an edible fruit and produces a good quality of lumber. The industry is conducted in a manner somewhat similar to the production of maple syrup or raw rubber. The gum is used as a base in chewing gum and is sent largely to the United States.

The collection is done by people who go into the forest for a few months each year, usually in May or June, when the sap is running most freely. A tree yields about 5 pounds at a tapping but can be tapped only once in every 5 years. As it is, about 25 per cent of the trees are killed. On account of this and because of the great demand that has developed for chewing gum since the World War, some of the large manufacturers of chewing gum are establishing plantations. They are not planting trees yet but are giving the wild trees in their large concessions more care and attention. The greater part of the chicle is now produced on the lands of these manufacturers, but there are still many who work independently, selling their product to contractors. The forested parts of Yucatan and other near-by sections of southern Mexico produce most of the world's chicle.

Minerals. All parts of Mexico are mineralized, and the country has long been famous for the exploitation of its mineral wealth. Since Spanish colonial days, over three billion dollars of silver alone have been mined, and the country still leads the world in silver production, contributing about 40 per cent of the annual supply. Now, however, the value of petroleum and of copper is normally greater than that of silver. Other important minerals are the ores of lead, zinc, gold, graphite, mercury, antimony, and arsenic. The leading silver-mining center is Pachuca to the northeast of Mexico City.

Petroleum is produced mainly in the Tampico and Túxpan districts. Output reached a peak in 1921, with 193 million barrels, and averaged 156 million barrels in 1921-1925, but it de-

clined to 33 million barrels in 1932 and 1933, and in 1937 was 46 million. Depletion of reserves and land laws unfavorable to operations by foreign corporations were responsible for the decline. A large part of the production is now refined in Mexico, all of the refineries except one being located along the Gulf. About 60 per cent of the output is exported. There are unexploited deposits in eastern Tehuantepec, and geologists think that there are reserves around the Gulf of California.

The majority of the remaining minerals are most important in Sonora in the northwest near the border of the United States. Copper moves across the border to Arizona smelters, and lead,

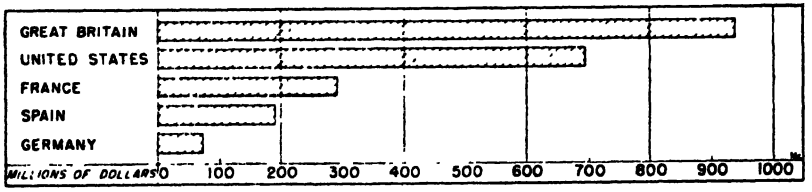


Fig. 268 Foreign investments in Mexico in 1935. (Figures from U. S. Dept. of Commerce.)

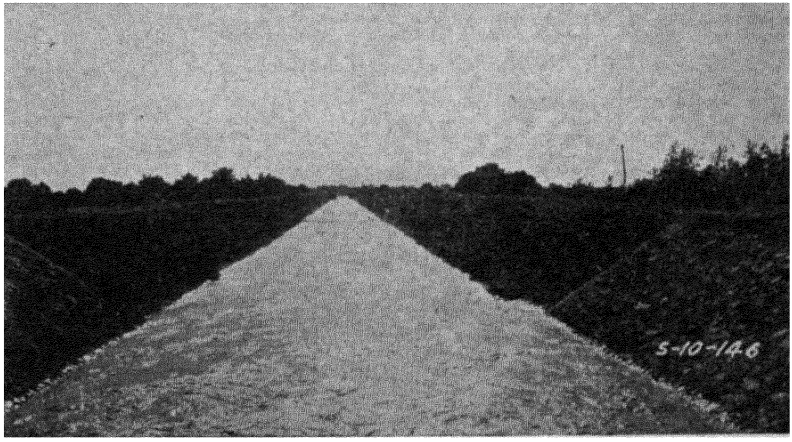
which abounds in association with other minerals, moves to Monterrey. The region around San Luis Potosí is another center, that city having one of the world's largest arsenic smelters.

About 97 per cent of the mining properties are owned by foreign capital, chiefly from the United States, but the application of recent laws regarding the ownership of Mexican resources will in time result in a greater proportion of domestic ownership. Of the total investments by people of the United States up to 1930, $230,000,000 were in mining and smelting and $200,000,000 in petroleum production and refining (Fig. 268).

Agriculture. Only 5 per cent of the total area of Mexico is under cultivation. Six times as much is in pasture and twice as much in forests. It is estimated that there is three times as much available agricultural land as is under cultivation and that 25 per cent of the country might be cultivated were there sufficient water

for irrigation. Over 4 million acres are now under irrigation, and a recent plan of the government calls for large expenditures for added facilities.

The fertile soil and varied topography and climate provide a good basis for agriculture. With better transportation, the variety of conditions should make much interchange possible among different parts of the country and provide some surplus for export. The methods of cultivation have been poor. The lack of knowl-



Officina de Divulgacion, Mexico

Fig. 269. Canal in the national system of irrigation of Mexico.

edge and of incentive have been responsible for this condition. It is likely that large holdings, the type of ownership which has prevailed but which now is being broken up, have discouraged greater crop production. In the dry parts only grazing is possible, but where peons were located on large agricultural holdings there was no incentive for them to do any more than they had to and the owners did not need to farm such immense holdings carefully in order to make them provide a considerable amount of cash. New land laws provide for dividing the large holdings among the peons, the rural village being the unit for holding land in common. Thus far almost 50 million acres have been distributed.

Crops. Corn and frijoles (beans) are the mainstays of the Mexican diet, but legumes, vegetables, and fruits are important. Other important crops are maguey, sugar cane, coffee, tobacco, the vanilla bean, alfalfa, bananas, cotton, wheat, henequen, and guayule. Maguey is a type of century plant from which a national drink called *pulque* is obtained. It is slightly more intoxicating than beer after fermentation and is shipped in large quantities into the cities. Vanilla extract is obtained from the bean of the vanilla plant, a climbing orchid that requires shady, humid conditions. Its production is very tedious and difficult. Each blossom must be fertilized individually, and great care is necessary in drying the bean to obtain the proper flavor. Guayule, from which rubber is obtained, is a small native plant of the arid regions.

Bananas, coffee, winter vegetables, and henequen are important export crops. The banana industry was begun in 1928 back of Tampico and has grown until Mexico ranks third in banana production and has recently reached first place as a source of imports for the United States. There is a winter-vegetable industry in the northeast and along the eastern shore of the Gulf of California, where irrigation is necessary. Shipments are made to both the United States and Canada. Tomatoes are the leading crop, but beans, peas, peppers, and eggplant also are grown. Coffee growing, which has expanded greatly during the past two decades, and which might be expanded still more, is chiefly in the region of Córdoba and Jalapa. The latter is also a leading tobacco-growing center. Mexico has excellent conditions for tobacco, and it is claimed that the country might easily be a rival of Cuba if more attention were given the crop and if Cuba did not enjoy preferential duties in American markets.

Henequen, one of the Agave family of plants, provides a fiber used for binder twine by our small-grain industries. The harvester-thresher has lessened the demand for it, but large amounts are still used. It is grown in the western part of the peninsula of Yucatan. The plant requires a dry, tropical climate. Western Yucatan is on the leeward side of the peninsula and has a porous

limestone base which permits underground drainage. This region also has a thin soil with many outcrops of the underlying limestone. The best fiber-producing Agaves require such soils, which are largely useless for other crops.

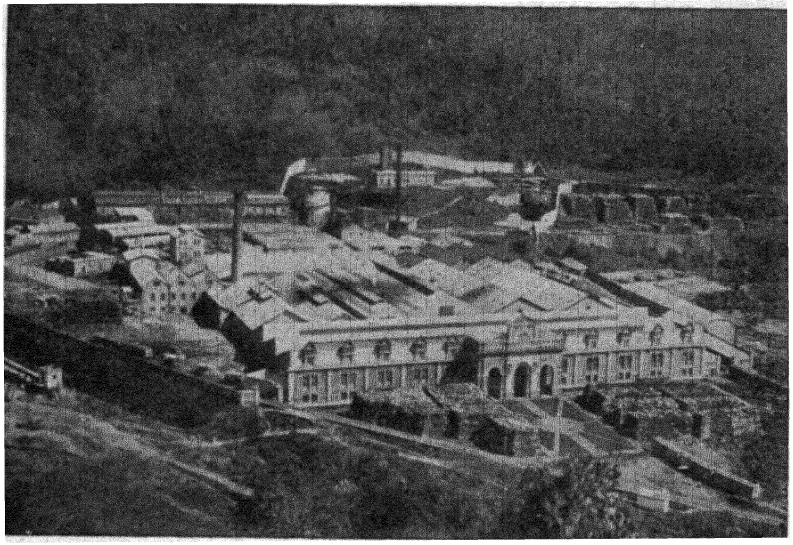
The growing of henequen requires capitalistic methods. The plants, grown on plantations, require several years of growth before they will produce fiber. In addition, factories must be built and equipped with the machinery that has been developed to separate the pulpy part of the leaf from the fiber, and railways must be constructed to haul the leaves from the fields to the factories. The industry is owned by Mexican capital.

Ixtle is another variety of Agave which grows in the dry part of central Mexico. It is now used by the Mexicans for textiles and is thought to have future possibilities.

The important irrigated crops are wheat, barley, cotton, sugar cane, vegetables, chick peas, and fruits. The leading irrigated section is the Laguna district near Torreón; another irrigated section is the vegetable district along the Gulf of California. There is also an extension of the Imperial Valley of California into Mexico, where vegetables and long-staple cotton are grown. This cotton is exported to the United States, and Mexico in turn imports cheaper, short-staple cotton from this country for use in the textile mills.

Animal industries. Mexico has 30 million animals (about the same as Spain or Turkey), which supply meat and dairy products for local consumption and hides, wool, and hair with which the handicraft industries and factories make needed products and which are exported. Cattle comprise a third of the number of animals, goats 23 per cent, sheep 20 per cent, and swine 13 per cent. Cattle and sheep are chiefly in the moist southern part of the plateau and in the mountains, goats in the dry northern part of the interior plateau. The animals are of poor quality, and the methods employed are primitive. The number has increased rapidly during the past several years. There is now a growing dairy industry around Mexico City.

Manufacturing. There is much manufacturing in Mexico to supply domestic needs, some of it being done in factories of considerable size. High freight rates on imports, abundant raw materials, considerable power, and cheap labor are favoring influences, but manufacturing is retarded by the lack of skill and the mental outlook of the laborers toward a higher standard of living, the sparsity of population and the low per capita purchasing



Pan American Union.

Fig. 270. Mexico: general view of the San Rafael Paper Mills, in the State of Mexico.

power, the lack of capital, and unstable political conditions. High freight charges cause most of the manufactures to be scattered throughout the country.

The manufacture of cotton textiles, tobacco, and metallurgical products are the leading industries. Other industries are paper, furniture, leather goods, tobacco, brick, tile, cement, sugar refining, the smelting and refining of minerals, flour milling, brewing, meat packing, and confectionery. There are a few factories for manufacturing wool and ixtle, but woolen products are made mainly on hand looms. Handicraft industries are widespread, and almost every town makes pottery, cigarettes, and straw hats.

Puebla, called the Manchester of Mexico, is also a great railway and commercial center. Other important textile-manufacturing cities are Hercules, Orizaba, Atlixco, Aguascalientas, and Saltillo. There are about 900,000 cotton spindles in the country.

Monterrey, a gateway city located in the center of a mining region, manufactures iron and steel, obtaining coal to its north, where the only important deposits of the nation occur, and iron ore from a mountain of iron ore near Durango. It also has flour mills, breweries, cotton and rayon factories, and a glass factory. Recently natural gas has been piped from Texas for fuel in some factories.

Mexico City, Aguascalientas, Torreón, and Chihuahua all have varied manufactures, and Léon is a leather and cutlery center. Mexico City has an iron and steel mill, the owners of which also have a plant at Piedras Negras on the Texas border for converting scrap iron into ingots.

Transportation. Mexico has about 17,000 miles of railway, a portion of which provides good service under normal conditions. Topography and the lack of economic development are handicaps to the expansion of transportation facilities. To move products to the outside world, long hauls over difficult mountain routes are necessary, and at present most Mexican products will not bear the required freight charges. Most of the existing railway mileage has been built for the purpose of exploiting minerals. The Federal Government controls and operates most of the mileage, a considerable part of which it owns. Half the British investment in Mexico is in railways (Fig. 268). The lines connect at several points with the railways of the United States and with the Guatemalan railway.

Large expenditures have been made by both the national and state governments during the past decade to increase the mileage of improved highways. There are now about 3,000 miles of surfaced roads, and an equal additional mileage has been planned. A paved road was opened recently between Laredo, Texas, and Mexico City. It is being extended to the south to connect with

the highways of Guatemala. The highways are being built to attract tourists and to encourage the development of agriculture and mining by making truck transportation possible.

Mexico also has about 13,000 miles of airways, giving connections with all parts of the United States and Central America.

Foreign commerce. In 1935 minerals comprised 73 per cent of the exports of Mexico. Silver comprised 28 per cent of total exports, petroleum and its products 20 per cent, and lead 10 per cent, followed in order by zinc, gold, and copper. Other important exports were coffee, cotton, bananas, winter vegetables, and henequen. Imports covered a great variety of goods, iron and steel, machinery, motor vehicles, chemicals, and textiles being the most important items. For a few years exports have been from 50 to 60 per cent greater than imports, and the total foreign trade recently has been about $200,000,000 (a little less than that of New Zealand or about equal to the combined foreign trade of Chile and Peru). The bulk of the trade is with the United States, for the past few years about 60 per cent, and imports and exports have been equally divided. For several years Mexico has stood first among the Latin-American republics as a market for our goods. The United Kingdom and the German Reich follow the United States in trading with Mexico but are far less important.

Veracruz, serving Mexico City, is the leading seaport. Tampico is the leading oil port and is the headquarters of several oil companies. On the west coast Manzanillo and Mazatlan are the principal ports. Acapulco has one of the best harbors on the entire Pacific coast of America but lacks sufficient railway connections and has a poor hinterland.

Future of Mexico. Mexico really seems to be a "beggar sitting on a bag of gold." There are varied and abundant mineral wealth and fertile agricultural lands inefficiently worked or awaiting irrigation for which much water is yet obtainable, and there is a supply of cheap labor; nor should favorable location near the great markets of the United States be forgotten. The people are poor and uneducated, and until recently the nation has lacked

rulers who were interested primarily in the welfare of the masses. Capital is scarce and cannot be attracted in large amounts from foreign sources under existing conditions. The only permanent obstacle seems to be scarcity of water, although the present supplies are not fully utilized. There is the basis for much greater agricultural and manufacturing industries than now exist.

Much economic progress may in time be realized from a six-year plan for economic development which was put into operation at the beginning of 1934. This plan provides for a reorganization of the school system, agrarian reform, internal improvements, domestic ownership of industry and resources, and government financial institutions and other institutions necessary to carry out the program.

49
FOREIGN COMMERCE

Trade routes. That territorial specialization is of fundamental importance in modern industrial society should now be evident to all students. In the preceding chapters we have tried to give clearly the environmental basis and the economic principles underlying this vital truth. The specialization whereby each section of the world produces the commodities for which it is best fitted involves the mutual dependence of the different sections. Commodities must be exchanged through the medium of the market place, and this process requires various types of efficient transportation agencies that come to operate over established zones or routes. Important overland routes have been indicated on various maps throughout the book; major ocean routes are shown in Figure 271. Seaports indicate where the two types meet, great seaports and great commercial centers arising where there is a hinterland that contributes a great volume of exports or where there is a great consuming market, or both.

The major factors in determining the location and the direction of trade routes are the location of cargoes to be moved and of markets for them. Trade routes connect surplus regions with deficiency regions. The exact paths of agencies operating on overland routes are controlled mainly by topography, but historical factors are also important. The paths which ships follow are determined by various factors, among which are distance, the shape of the earth, winds, ocean currents, fog, ice, dangerous shoals, and supplies of fuel. Other things being equal, a ship would take the shortest distance between two points; because of the shape of the earth this is the arc of a great circle. Favorable winds and ocean

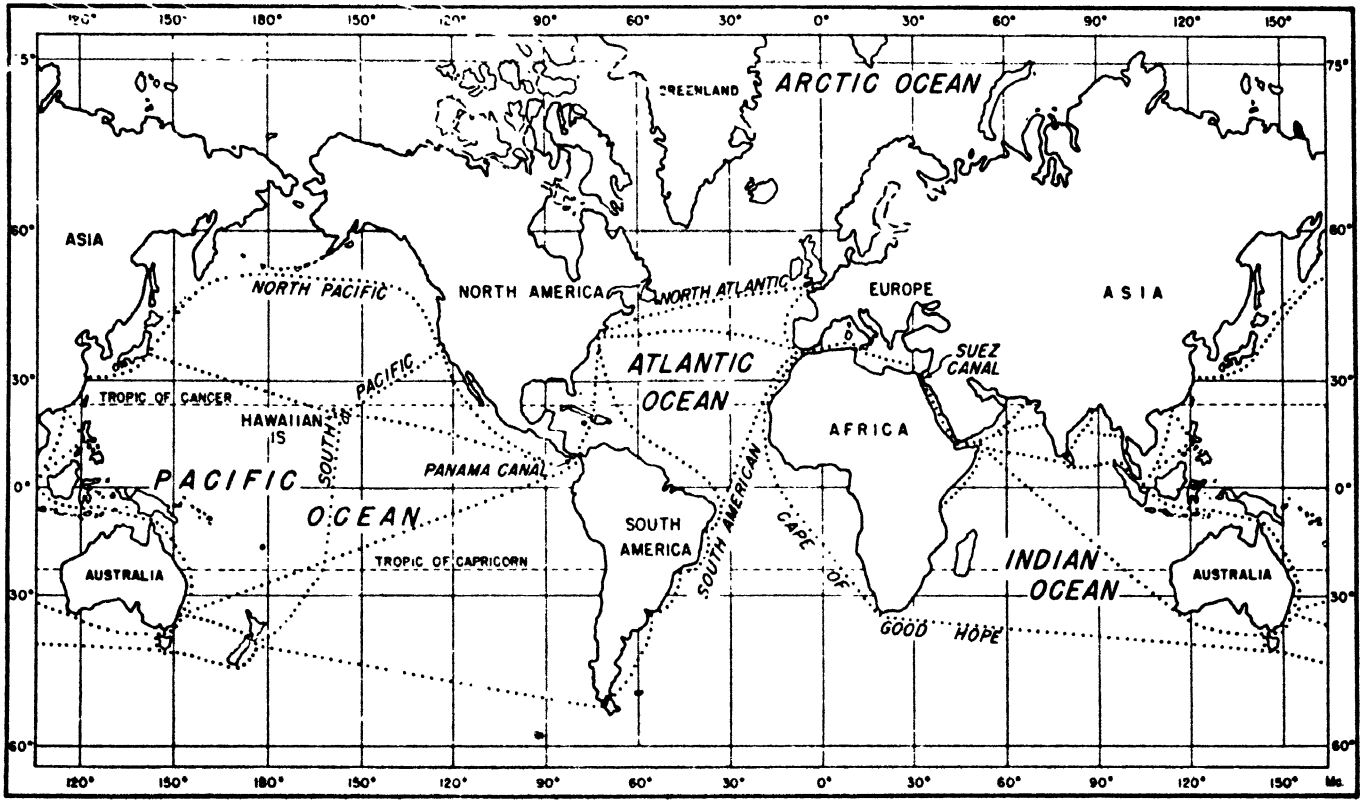


Fig. 271 World's principal ocean routes.

currents are not so important to steam as to sailing vessels, but, in order to save fuel, the former take advantage of them whenever possible. Icebergs are a serious hazard on the North Atlantic route in early summer and are made more so by fogs that prevail where the warm Gulf Stream meets the cold Labrador current. Sable Island off Nova Scotia and the region of Cape Hatteras both are ocean graveyards.

Since a shipowner makes money from hauling cargo, he tries to have as little fuel on board as possible. The location of fueling stations, therefore, influences the amount of fuel which must be carried and the path which the ship will take. Oil-burning ships have a greater cruising radius than those which burn coal; the rise of the former, therefore, has caused a decline in the importance of many former coaling stations.

There are two types of trade routes, namely, trunk routes and feeder routes (Fig. 271), products being assembled at or distributed from important commercial centers or terminals of the trunk routes by feeder routes which spread like fingers from those places.

Attention will now be turned from trade routes to a discussion of the advantages of territorial specialization and the resulting commerce.

Basis of foreign commerce. Commerce among nations, like that among the different regions within a nation, arises because of the superiority of particular locations for producing certain products. This superiority may spring from one or more of three causes: (1) differences in geographic conditions—climate, physical features, and natural resources; (2) differences in the capabilities of the people—for example, the ability of the Orientals in the handicrafts or of enterprisers in the United States in organizing and operating large-scale industries; and (3) differences in the stage of industrial development or of acquired factors, much of the trade between the United States and Europe and, in fact, much of the trade of the world having always resulted because of this factor. The United States is young compared with Europe and

until recently was an important exporter of foods and raw materials, receiving in return manufactured goods.

Nations advance industrially, and people migrate to and export machinery (the results of their inventive abilities) to various parts of the world. Much world settlement spread from Europe as a center, and while in some respects that continent is culturally far ahead of the remainder of the world, other countries have tended to catch up with it industrially. Differences in geographic conditions remain then as the most permanent basis for the exchange of goods among the different parts of the world, although even soils, forests, and minerals may become exhausted.

Advantages of foreign commerce. Foreign commerce makes it possible for the people of a country to enjoy to a certain degree any superiority which other countries possess. This superiority results in a lower unit cost for certain products; they can be produced with a smaller expenditure of productive energy than in other countries. If this principle is followed worldwide, each commodity will be produced where its cost is lowest—where the greatest amount of production possible with a given amount of productive energy is obtained. The result is a higher standard of living than if a part of the goods were produced where the advantages for its production were fewer. Assume that a country needs a million bushels each of rye and wheat annually and could, on an equal area of land and with equal applications of capital and labor, produce 3 million bushels of wheat alone or 1 million bushels of wheat and an equal amount of rye by dividing the energies: it would pay to grow wheat alone because a million bushels could be exchanged for the rye needed, and there would be yet another million bushels to exchange for other products.

A given country might possess advantages over other countries for the production of several commodities, but that it should try to produce all of them does not necessarily follow. It should produce the one or ones in which it has the greatest comparative advantage, that is, the ones which, with a given expenditure of productive energy, will return the greatest surplus above the cost of

production. This surplus can be exchanged for other products, and both parties to the exchange will gain.

Government control and aid of foreign commerce. However, world production is never in accordance with the ideal pattern described in the preceding section. Different groups of people have ambitions of one sort or another which cause them to devise obstacles that prevent the smooth movement of goods, with the result that many industries are located uneconomically and standards of living are consequently lower. These interferences may take the form either of controlling imports with protective tariffs or other means or of encouraging exports with subsidies, favorable freight rates, or other forms of aid. Since the World War many such measures have been employed by the majority of countries. There has been a marked trend toward what is called economic nationalism or national self-sufficiency.

Economic nationalism. There is space for only a few general statements concerning the ramifications of the tendencies which have almost wrecked the modern world. Economic nationalism had its inception in the World War but has been aggravated by postwar developments. There are several reasons for the economic condition in which we now find ourselves. First is the disruption caused by military needs during the War. After the conflict ended, it was often impossible to abandon uneconomic enterprises without adding further to economic dislocation. Some industries were kept because of military defense, others to prevent unemployment, and still others because of unfavorable conditions in agriculture. In the postwar period widespread impetus was given to industry by the export of American capital, by technical changes, and by the development of automatic machinery. These influences made it possible for existing manufacturing countries to expand their industries and for manufactures to arise in new countries. Still later came the worldwide depression of the early thirties and the currency disturbances and other troubles that resulted.

Throughout this entire period we have witnessed also several

radical political changes accompanied by new economic policies, which have had the effect of further dislocating economic organization. On the whole these political changes have grown out of economic stress, but they have added further to political uncertainty and instability and in this manner have tended to keep the economic machine dislocated.

Much harm has been done, but, given considerable time and freedom from another devastating war, the world may eventually readjust its economic machine in a manner approaching prewar

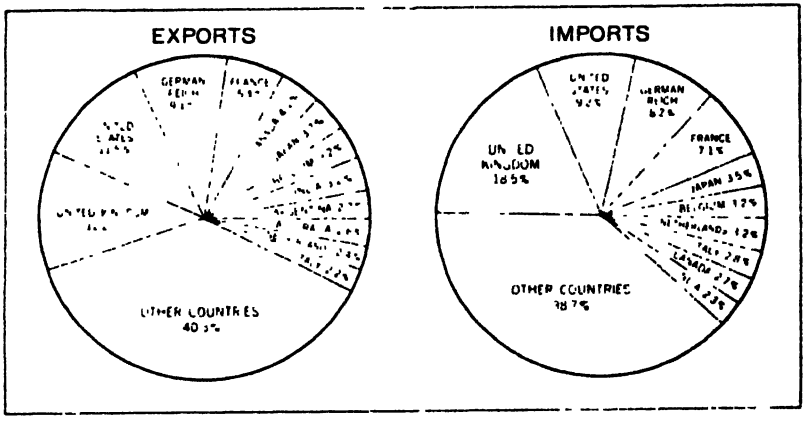


Fig. 272. Proportion of the total foreign commerce of the world shared by the leading commercial nations in 1936.

conditions. We must recognize, however, that preparations for another war, whether it comes or not, and the accompanying development of national self-sufficiency, can only mean a lowering of the standard of living for all the peoples of the world. The standard of living of millions is certainly much lower than formerly. Unemployment growing with the depression has been mitigated in instances by rearmament programs, but were the countries of the world willing to live peaceably with one another, how much more good the same expenditure of funds might do in providing needed public improvements of many sorts, while at the same time helping to provide employment.

Economic nationalism and the United States. Since foreign commerce normally comprises only 8 or 10 per cent of the total

commerce of the United States, some people are inclined to belittle its importance. It should be remembered that domestic and foreign commerce are but the two parts of a whole. Foreign commerce always has been important to the welfare of the country and will continue to be important. Abundant and varied resources, a high division of labor and specialization of industry, cheap transportation, and the widespread use of machinery create

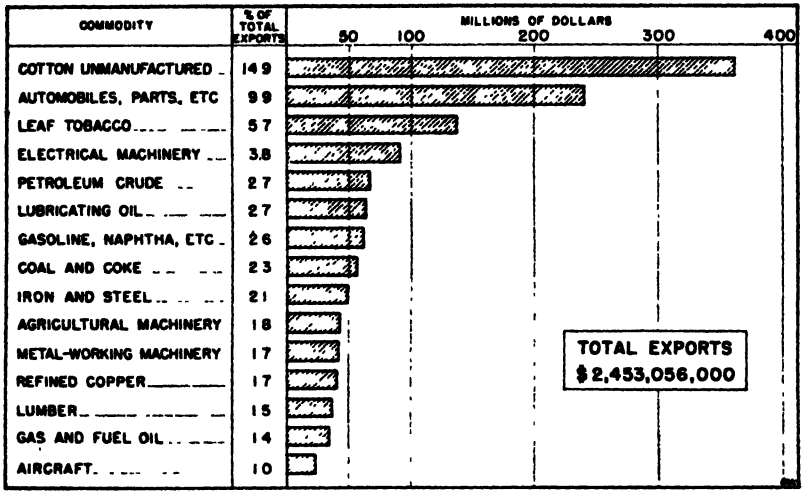


Fig. 273. Principal exports of the United States in 1936.

the conditions for a volume of production that requires foreign markets to justify the scale and methods. We have superior advantages in certain industries because of these factors, and it is to our advantage and the advantage of the people of other countries that the possibilities be utilized. About 60 per cent of our exports are now such types of manufactures. The latest available figures show that we export

. . . 50 per cent of our annual production of cotton; 36 per cent of our tobacco; 40 per cent of our dried fruits; 65 per cent of our patent side upper leather; 51 per cent of our gum rosin; 30 per cent of our lubricating oils; 36 per cent of our lubricating greases; 66 per cent of our refined copper; 14 per cent of our radio apparatus; 23 per cent of our power driven metal-working machinery; 35 per cent of our sewing machines; 39 per cent of our printing and book binding machinery; 27 per cent of our office appliances;

30 per cent of our agricultural machinery; 21 per cent of our tractors; 37 per cent of our aircraft; and 43 per cent of our borax.[1]

If this trade declines, ocean ships and the railways serving the seaports have less to haul, commercial and financial institutions engaged in providing services for foreign trade have less business, agriculture and manufacturing become depressed in several lines,

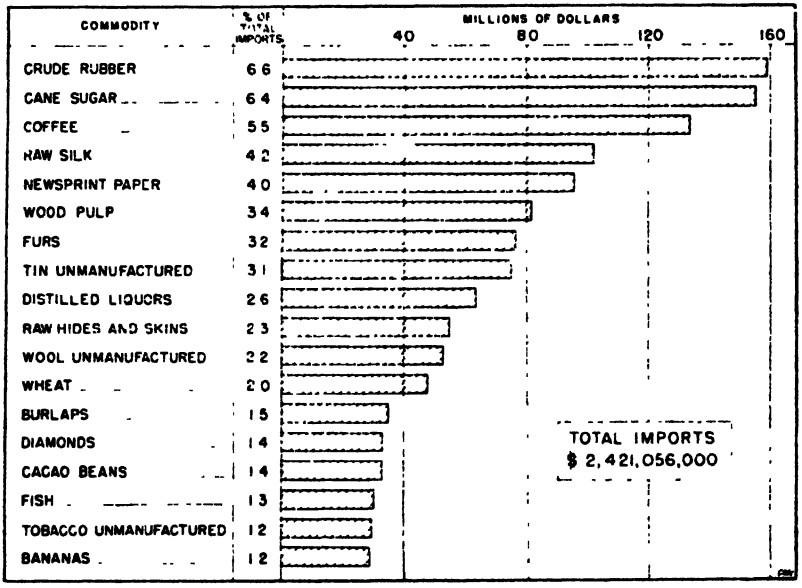


Fig. 274. Principal imports of the United States in 1936.

and, while adjustments may be made in time, a great deal of economic dislocation results.

Again, if we do not import, our exports will decline seriously. Events since 1914 have changed us from a debtor into a creditor nation, and have attracted a large portion of the gold supply of the world to our shores. With our control of so much of the gold, foreign merchants have nothing with which to pay for our surplus products if we will not accept their goods.

The bulk of our imports are raw materials and foodstuffs, many of which are processed or manufactured in this country, thus giv-

[1] *Factors Affecting Foreign Trade*, U. S. Dept. of Commerce, 1936, p. 8.

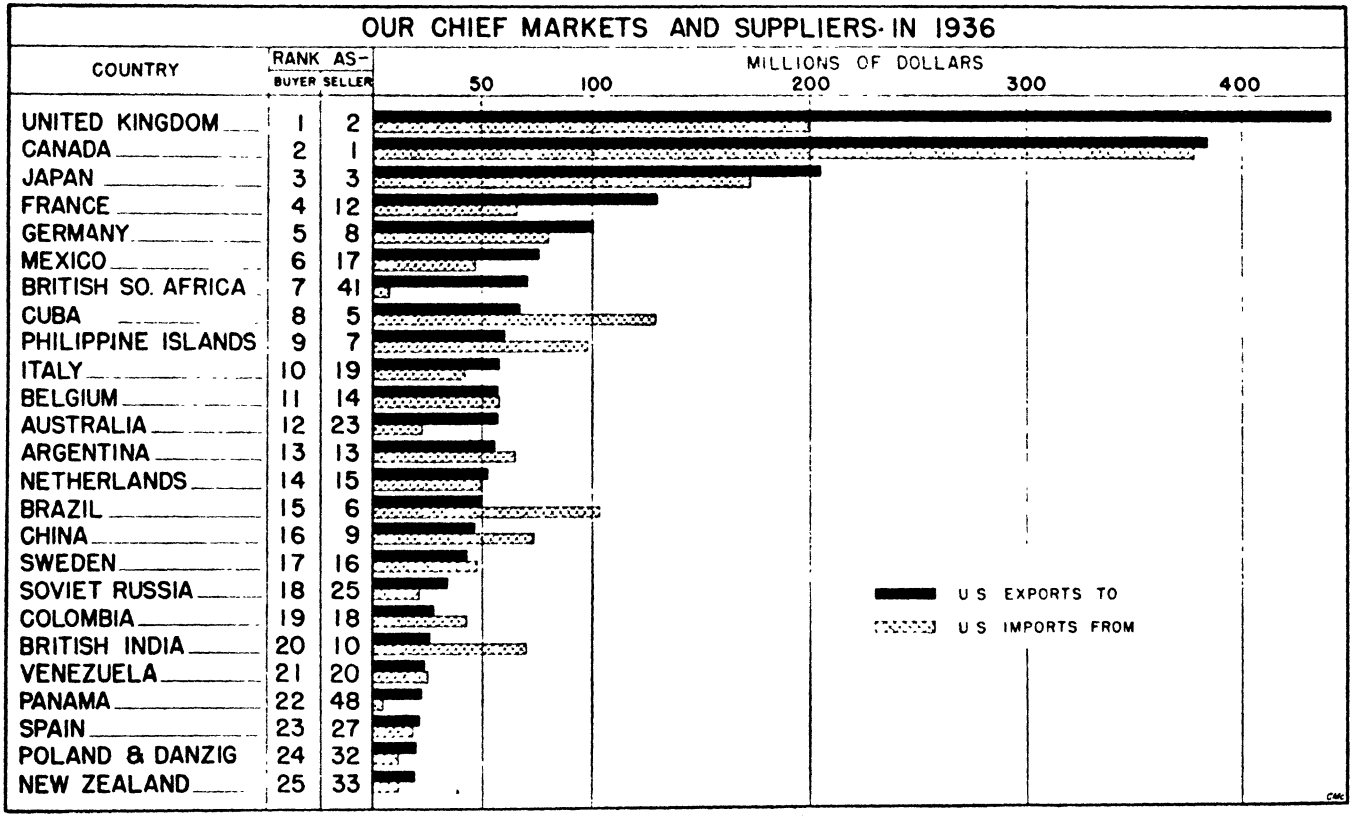


Fig. 275. United States markets

ing work to our factories and employment to labor and swelling the total of domestic commerce as they move along the route to the ultimate consumer. In 1921 agricultural products were 52 per cent of our total exports, in 1936, only 26 per cent. The quantity of pork and lard exported in 1929 was 7 times that of 1936 as was likewise the case with wheat. The decline must be attributed largely to the movement for self-sufficiency in Europe. On the other hand, our exports of fresh, canned, and dried fruits, industrial machinery, automobiles, and chemicals have grown rapidly since the World War, and the percentage exported was roughly the same in 1936 as in 1929. Some of these industries, however, have developed largely since 1920. But our exports are tending more toward manufactured products of a type in which American methods of manufacture and American engineering skill are important influences.

The United States could probably be self-sufficient more easily and at less cost to the consumer than any of the other important nations. But to obtain supplies of rubber, for example, under the present condition of the processes for getting it from domestic sources, would result in such a high cost of production as to reduce the use of automobiles and gasoline and other products. Then other countries would be less able to import these products from us because of their higher unit cost in many instances. When a country tries to make itself self-sufficient, it uses its own supplies of natural resources more rapidly and has less goods and higher-priced goods for its people to consume. And because it does not buy from the outside, it is unable to sell there.

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INDEX

A

Abaca, 643-644
Abadan, 562
Abrasives, 56, 59
Acacia trees, 425–426
Acapulco, 761
Accessory industries, 3
Accountancy, 1, 4
Accra, 422
Acetate of lime, 34
Acetate process, 303
Acetylene gas, 333
Acid phosphate, 88
Acorns, 207, 444
Aden, 564
Aegean Islands, 549
Afghanistan, 566
Africa, 7, 123, 412-428, 441–449, 459–461, 464, 470-473, 555 558
Agaves, 757, 758
Agrarianism, 29
Agriculture (*See also* agriculture *under the various countries*)
  geography of, 22
  income of, in U S, (*chart*) 27
  people employed, in U S, 22, (*chart*) 26
  plantation, southeast Asia, 636
  regions in U S, 19-23
  single crop in cotton, 243-245
Aircraft, 342 343
  centers of manufacture in U S, 343
  rise of air transportation, 342
Air cure for tobacco, 227
Alabaster, 61
Alaska, 83, 360, 361-367
  agriculture, 365 366
  fisheries, 364
    production and value, 133
  foreign commerce, 367
  forests, 363
  furs and trapping, 364
  grazing, 364 365
  Matanuska Valley, 366
  minerals, 363-364
  natural features, 362-363, (*map*) 362
  retarded development, 361-362
Albania, 548-549
Albemarle Sound, 134
Albury, 654
Alcoa (Tenn.), 83
Alcohol, 34, 127, 319, 334, 731
  uses of, 333
Aleutian Islands, 362
Alexandrovsk, 570, 583
Alfa grass, 444, 471
Alfalfa, 161, 163, 169, 179, 222, 264, 265, 386, 418
  Argentina, 697-698, 699
Algeria, 442, 443
Alkali, 50
  manufacture and uses, 330-333, (*chart*) 332
Allahabad, 621, 629
Alloy steels, 66, 278, 283, 338, 351
  manufacture in U S, 67
  markets for, 73
Allspice, 737
Almonds, 203, 205, 212
Alpaca, 683, (*photo*) 683
Alpine tunnels, 462
Alps Mountains, 464, 466, 500, 501, 508, 528, 530
Alsace, 439
Altai Mountains, 575
Altare Pass, 464
Alumina, 82
Aluminum, 18, 62, 63, 74, 81-83, 329, 339
  alloys, 38
Amalgam, 84
Amalgamation, 84
Amazon River, 685, 718
  valley, 710, 712, 718
Amber, 525
Ambergris, 493
Ammonia, 90, 91, 326, 329, 330
Amsterdam, 482
Amur River, 598
Anatolia, 560
Andalucia, 451
Andes Mountains, 668, 670, 671, 674, 680, 693, 710
Anglo-Egyptian Sudan, 425-428
  foreign commerce, 427-428
  geographic features, 425
  products, 425-427
  transportation, 427
Angola, 419, 460, 562
Angora goats,
  British South Africa, 417
  Turkey, 561
  United States, 253, 267
Animal industries (*See also* animal industries *under the various other countries*)
  Argentina, 697-699
  Australia, 654-657
  Brazil, 715-716
  British Isles, 403-404

Animal industries (*Cont.*):
British South Africa, 416-418
Canada, 388
France, 438
Germany, 508-509
New Zealand, 664-665
U.S.S.R., 579
United States, 22, 167, 255-273
Animals:
draft, in U. S., 268-270, (*map*) 269
game, 30
importance to man, 255
Ankara, 562
Annapolis Valley, 386
Anshan, 599
Antigua, 732
Antimony, 19, 607
Antofagasta, 677, 678, 687, 702
Antwerp, 477-478
Apennines, 464
Appalachian coal region, 106-108
Appalachian highlands, 13-14, 16, 18, 295, 296
Appalachian region of Canada, 376-377
Appert, Nicolas, 315
Apples, 318, 436, 508
Apricots, 318
Aquitaine Basin, 430, 431, 436
Arabia, 563-564
Aragon, 451
Archangel, 570, 583
Arc process, 91
Arctic, 378
plain of Alaska, 362, 363
Ardennes, 476
Argentina, 693-703
agriculture, 695-697
animal industries, 697-699
climate, 693
crops, 695-697, (*chart*) 694
foreign commerce, 702-703, (*chart*) 703
geographic features, 693
large estates, 694-695
manufactures, 700-701
minerals, 700
natural regions, 693, (*map*) 692
quebracho, 701-702
seaports, 703
transportation, 701-702
wine industry, investment in, 697
Arges Basin, 545
Arica, 678, 687
Aroostook district, 179
Arrowroot, 738
Arsenic, 85, 86
Artesian wells:
in Australia, 649, 650, (*map*) 649
in the Sahara, 446
Asal plain, 472
Asbestos, 74, 93, 381, 415
Asia, southeastern, 632-647
agriculture, 636-644
climate, 634
field crops, 636-638
foreign commerce, 644-645
exports, (*chart*) 645
imports, (*chart*) 646
volume, (*chart*) 644
forests, 634
geographic features, 632, 634
importance to mother countries, 645-647
Asia, southeastern (*Cont.*):
minerals, 634-636
other crops, 644
people, 632
political divisions, 632, (*map*) 633
areas and population, (*chart*) 634
tree crops, 638-644
Asphalt, 731
Assam, 623, 628
Astrakan, 583
Asuncion, 705, 707
Aswan Dam, 556, 557
Atacama Desert, 91
Atlantic Drift, 570
Atlas countries, 442-444
agriculture, 443-444
animal industries, 444
fisheries, 443
foreign commerce, 442
exports, (*chart*) 444
geographical features, 442
minerals, 442-443
Atlas Mountains, 442
Atratro River, 742
Attar of Roses, 547
Auction warehouse for tobacco, 234-235
Auger method, 116
Augite, 48
Aukland Peninsula, 664
Australia, 7, 648-662
climate, 650-651
crops, 657-659
fisheries, 651-652
foreign commerce, 661-662
imports, (*chart*) 661
forests, 651
geographic features, 648-650, (*map*) 649
irrigation, 659
manufactures, 659-660
minerals, 652-654
natural regions, 648
pastoral industries, 654-657
seaports, 662
transportation, 660-661
water power, 654
Austria, manufactures of, 511-512
Autarchy, 487, 514, 515
Automatic machinery, 292, 312
Automotive accessories, 341
Automotive equipment, 339-342
assembly of, 340
centers of manufacture, 341-342
costs of, 340
importance of, 339
organization of industry, 340-341
Aviation, 137, 342, (*photo*) 342, 377, 381, 384, 573, 574, 635, 718, 748, 761
transpacific, 361, 369
Avocado, 195, 197
Aydin, 560, 561
Ayrshire, 260, 401
Azores, 458

B

Bagasse, 319, 368
Bahamas, 730, 731, 736
Bahia, 711, 713
Bahia Blanca, 702, 703
Bahrein Islands, 563, 564

Baker Island, 360, 369
Bakery products, 221, 307, 313, 322
Baking quality of wheat, 148
Balboa, 749
Balearic Islands, 450
Balkan Mountains, 540, 546, 547
Ballast, 50, 59, 61, 477
Baltic Heights, 500, 503, 518
Baltic Sea, 497, 498
Baltic States, 516, (*map*) 524, 524–527, 542
  agriculture, 525-526
  climate, 525
  foreign commerce, 526
  future, 527
  geographic features, 524-525
  historical factors, 516
  manufactures, 526
  natural resources, 525
  seaports, 526
Bamboo, 588-589
Bananas, 643, 658, 689, 706
  Central America, 743-745
  Colombia, 727
  Mexico, 757
  West Indies, 736
  wilt, 745
Banka, 635
Baranquilla, 727
Barbados, 728, 730, 739
Barcelona, 456, 457, 458
Barley, 313, 455, 626
  Atlas countries, 444
  China, 609
  India, 626
  natural requirements, 155
  U.S.S.R., 577
  United States, regions of production in, 155-156
  uses, 154
Barran Falls, 654
Basalt, 47, 50, 54
  uses, (*chart*) 53
Basel, 532, 533
Base load, 352
Basra, 563
Bass:
  channel, 135
  sea, 132
  striped, 134
Basutoland, 416
Batavia, 643, 645
  rainfall, (*chart*) 635
Bauxite, 81, 453, 454, 543, 723
  France, 434
  mining, (*photo*) 82
Bavarian plateau, 500, 511
Bay of Bristol ports, 83
Bay rum 738
Bay tree, 738
Beans, classes of, 180-181
Bechuanaland, 415
Beech, 503, 530, 542, 674
Beef-extract, 697, 704, 716
Beef production, 255-258
  Argentina, 698
  Australia, 657
  United States, regions, 257-258
Beer, 142, 154
Bees, 221
Beeswax, 222
Beet pulp, 320
Beira, 419
Belfast, 406, 408
Belgian Congo, 78, 461, 478-479
  foreign commerce, 479
  geographic features, 478
  minerals, 478-479
  products, 478-479
  transportation, 479
Belgium, 474-478
  agriculture, 476
  foreign commerce, 477-478
  geographic features, (*map*) 475
  manufactures, 476
  minerals, 476
  natural regions, 476
  people, 474
  seaports, 477-478
Belize, 749
Belle Isle, 380
Benguella, 419, 460
Benguella Current, 413
Bent grasses, 161
Bergen, 494
Bering River Valley, 364
Bermuda grass, 167
Bermudas, 740
Bessemer process, 274, 280, 281, 282
Bilbao, 454, 458
Billiton, 635
Birmingham (England), 401, 406
Birmingham (Ala.) district, 13, 64, 65, 106
Blackberries, 199, 200
Blackboards, 58
Black Sea, 568, 583
Blast furnace, 278, 279, 283, (*photo*) 279, (*diagram*) 280
  by-products of, 90
Bleaching textiles, 293
Bloom, 284
Blooming mill, 284
Blue fox, 364, 384
Blue Nile, 425, 427, 472, 555
Blueberries, 200, 201
Bluefish, 132, 134
Blue Ridge Mountains, 13
Boats, for iron ore, 277-278
Bogotá, 726
Bohemia, 528, 535, 536
Bohemia, Moravia, Slovakia, 535-537, (*map*) 534
  agriculture, 535
  foreign commerce, 536-537, (*charts*) 536, 537
  manufactures, 535-536
Bolan Pass, 620
Bolivia, 83, 685-687
  agriculture, 686
  coca, 686-687
  foreign commerce, 687
  geographic features, 685
  minerals, 685-686
  transportation, 687
Boll weevil, 239, 240-241
Bombay, 629, 630
Bone black, 318
Bora, 466
Borax, 89, 674
Bordeaux, 439, 440
  temperatures, (*chart*) 433
Borneo, 634, 635, 636

Boulder Dam, 284
Bowman, Isaiah, 615
Brahman cattle, 258
Brahmaputra River, 617
Braila, 542, 545-546
Brass, 71, 74
Brazil, 707-720
  agriculture, 712-715
  animal industries, 715-716
  climate, 707, 710, (*chart*) 709
  coffee, 713-715, (*map*) 708
  crops, 712-715
  foreign commerce, 718-719, (*chart*) 719
  forests, 710-711
  geographic features, 707
  manufactures, 716
  minerals, 711
  natural regions, 707
  seaports, 719
  transportation, 716-718
  water power, 711
Brazilian highlands, 668, 707, 710
Brazil nuts, 205, 212, 710-711
Breakfast foods, 142, 148, 154, 313, 314
Brenner Pass, 500
Brie, 432, 439
British Africa, significance of, to British, 428
British Columbia, 378, 380, 381, 387
British East Africa, 422-425
  climate, 423
  crops, 423-424
  foreign commerce, 424-425
    exports, (*chart*) 425
  forests, 423
  geographic features, 422-423
  seaports, 425
  transportation, 423, 424
British Honduras, 741, 745, 749
British Isles,
  agriculture, 401-403
  animal industries, 403-404
  chemical industries, 408
  climate, 398
  coal fields, 399-401
  commercial advantages, 396
  fisheries, 398-399
  foreign commerce, 409-411
  geographic features, 397-398
  iron and steel, 406-408
  manufactures, 404-409
  minerals, 399-401
    coal fields, (*map*) 400
  pottery industry, 408
  reasons for rise, 396
  seaports, 411
  textiles, 404-406
British Malaya, refining tin ore in, 83
British preferential tariff system, 1, 386, 389, 410, 700
British South Africa, 412-420
  agriculture, 415-416
  animal industries, 416-418, (*map*) 417
  climate, 413
  foreign commerce, 419-420
    imports, (*chart*) 419
  geographic features, 412
  manufactures, 418
  minerals, 414-415
  mining centers, 414-415
  natural regions, (*map*) 414
British South Africa (*Cont.*):
  political divisions, (*map*) 413
  seaports, 419-420
  transportation, 418-419
British thermal unit, 103
British West Africa, 420-422
  crops, 420-422
  diseases, 420
  foreign commerce, 422
  importance, 420
  minerals, 422
  transportation, 421-422
  tsetse fly, distribution of, (*map*) 421
Brittany, 436
Broken Hill (N.S.W.), 652, 659
Broken Hill (N. Rhodesia), 415
Broken Hill Mining Company, 653
Bronze, 74, 83
Broom corn, 165
Bucharest, 545, 546
Buckwheat
  China, 609
  natural requirements, 158
  United States, region of production, 157-158
  uses, 157
Budapest, 545
Buenaventura, 727
Buenos Aires, 677, 687, 693, 697, 700, 702-703, 704
Bulgaria, 546-547
  agriculture, 546
  export, 547
  manufactures, 547
  ports, 547
Bunker fuel
  coal
    Australia, 653
    British South Africa, 415
    Chile, 674
    Japan, 589
    Labuan, 636
    United States, 106, 108
  petroleum,
    United States, 115-116
Burma, 622, 623, 624, 629, 636
Bush fruits, 199-201
Butte, 75, 79, 81, 86
Butter, 259, 320, 321, 661-665, 699
  exporting countries, (*chart*) 484
Buttermilk, 320
Butternuts, 203, 206

C

Cable tool method, 116
Cacao, 681, 746
  Brazil, 713
  British West Africa, 420, 421
  Ecuador, 688
  French West Africa, 446
  Venezuela, 725
  West Indies, 735
Caffeine, 627
Calcite, 48
Calcium carbide, 329
Calcutta, 630, 631
Caliche, 675
Callao, 685
Camels, 444, 563, 615, 629, 682

Camphor, 334, 597
Canada, 4, 7, 40, 85, 92, 93
  advantages for pulp manufacture, 391
  agriculture, 384 388
  animal industries, 387
  central plain, 378
  clay belt, 376
  fisheries, 382 383
  foreign commerce, 392-395, (*chart*) 393
    in wheat, 386
  forests, 378 379
  freight rates, 385, 386, 391
  fruits, 386 387
  furs, 383
  manufactures, 388-392
    favoring influences, 389
    leading industries, (*chart*) 389
    retarding influences, 389
  minerals, 379 381
    production, 380 381
    value, 380
  natural regions, 375 378, (*map*) 377
  people, 375
  pulp and paper, 390 392, (*photo*) 390, (*map*) 391
  relations with U. S., 375
  seaports, 394-395
  transportation, 376, 378, 379, 381, 386
  water power, 381
Canary Islands, 458, 459
Canning foods
  economic importance, 315
  history, 315
Canning industry in U. S., 288, 289, 307, 315 317
  centers of canning, 316-317
  fruits canned, (*chart*) 317
  markets for, 317
  organization of, 315 316
  vegetables canned, (*chart*) 317
Cantabrian Mountains, 450, 453, 454
Canton Delta, 608
Cape Breton Island, 380
Cape Hatteras, 134, 765
Cape St Roque, 676, 721
Cape to Cairo railway, 418
Cape Town, 416, 418, 419
Cape Verde Islands, 459
Capital, 3, 19, 29, 37, 216, 268, 291, 304, 306, 325, 450, 472, 483, 543
  lack of:
    India, 631
    Spain, 450
    Turkey, 561
    U.S.S.R., 570
  sources in early New England, 3
  supply, 1
Caracas, 724, 726
Caravan routes and trade, 444, 471, 559, 565
  of Chinese Empire, 615-616
Carbolic acid, 334
Carbon, 63, 67, 103, 278
Carbon black, 122
Carbon disulphide, 329
Carborundum, 329
Cardiff, 407, 411
Carding, 293, 298, (*photo*) 294
Caribbean countries (*see* Island republics and colonies)
Carnaba wax, 710
Carob, 206-207
Carpathian Mountains, 500, 538, 545
Carpets, 299, 477, 630
Carrara, 467
Cascara buckthorn, 46
Casein, 320, 322, 699
  vegetable, 183
Cashew nuts, 212
Cast iron, 280
Cattle
  Argentina, 698
  Australia, 656 657
  Brazil, 715 716
  breeds
    beef, 256
    dairy, 260
  desirability of, 256
  Madagascar, 448
  tick, 258
  United States, 255-262
    beef, regions of production, 256-258, (*map*) 257
    dairy regions of production, 261-262
Cauca Valley, 727
Caucasus Mountains, 574, 575, 579
Caustic soda, 326, 330
Cedar, 363, 573, 711
Celluloid, 322, 334
Cellulose, 39, 146, 302, 326, 334, 392
Celotex, 319
Cement, 38, 90, 326
Central, 217, 319, 637, 732, 733, (*photo*) 733
Central America
  animal industries, 747
  bananas, 743 745
  coffee, 745 746
  foreign commerce, 748-749
  forests, 742-743
  geographic features, 741-742, (*map*) 742
  minerals, 743
  other crops, 746-747
  people, 741
  seaports, 749
  summary, 749-750
  transportation, 747-748
  water power, 743
Central Railway of Peru, 684
Central stations, 99, 355, 382
Central Valley of California, 187, 188, 190, 191, 198
Ceramics ware, 59
Cereals (*See also* cereals *under the various other countries*):
  Argentina, 695-696
  Australia, 657
  British South Africa, 416
  Canada, 385 386
  China, 608-609
  France, 435
  India, 625-626
  qualities of, 140
  U.S.S.R., 577-578
  United States:
    growing of, 140-160
    manufacture of, 311-313
  use of, 140
Ceylon, 93, 619, 621, 628, 631
Chaco, 693, 698, 705
Champagne, 437
  wine district, 430

Channeling machines, 50, (*photo*) 55
Channel Islands, 396, 403
Cheese, 320, 699
  Canada, 388
    markets for, 388
  exporting countries, (*chart*) 481
  manufacture, 321
  New Zealand, 665
  Norway, 494
  varieties:
    American, 321
    Italian, 468
    Swiss, 531
Chemical industries, 55, 86, 90
  British Isles, 408
  Germany, 510, 511
  United States, 324-336
    advantages in, 327
    American contributions, 327
    location, 328
    organization, 327 328
    products made, 329 334
Chemistry, industrial services of, 324
Chernozem, 577
Chesapeake Bay, 344
  fishery products, 133, 134
Cheshire, 401, 403
Chestnut, 44, 45, 453, 530
  blight, 45, 206
  extract, 44
  native, 206
  oriental, 206
Chewing gum, 754
Chicago, 26, 108
  location, 26
  meat packing, 311
  steel industry, 287
Chicaima Valley, 680
Chicle, 743, 754
Chicory, (*footnote*) 181
Chile, 91, 670-678
  agriculture, 676
  animal industries, 676
  climate, 672-673, (*chart*) 673
  crops, 676
  foreign commerce, 677-678, (*chart*) 673
  forests, 674
  geographic features, 671-672
  manufactures, 676-677
  minerals, 674-675
  natural regions, 672-673
  seaports, 678
  transportation, 677
  water power, 675-676
Chilean nitrate, 90, 674-675
China clay, 60
Chinchilla, 684
Chinese Empire:
  agriculture, 607-612
  animal industries, 612-613
  crops, 608-612
  floods, 603, 604
  foreign commerce, 614-615
  geographic features, 603-605, (*map*) 602
  manufactures, 613-614
  minerals, 605-607
  outer provinces, 615-617
  river valleys, 603-604
  seaports, 615
  unprogressiveness, reasons for, 601-603
Chinook winds, 385, 386
Chlorine, 95, 96, 326, 330, 332
Chocolate, 420, 531, 660
Choco River, 726
Chosen, 584, 596, 599
  crops, 596
  natural resources, 596
Chromite, 68, 415, 636, 731, 743
  Turkey, 561
Chromium, 19, 63, 68
Cider, 436, 531
Cigarettes, 230, 232, 235
Cigars, 233, 638
Cinnamon, 643
Cinnibar, 85
Citrus fruit:
  Australia, 658
  Brazil, 712 713
  British South Africa, 416
  China, 610
  importance of, 192
  Italy, 468
  Palestine, 558
  Paraguay, 706
  Spain, 455, (*map*) 455
  Tunis, 444
  U.S.S.R., 579
  United States, 192-195
    future of, 195
    production, 194
    relative values, 195
  West Indies, 735-736
Ciudad Bolivar, 725
Clams, 132, 135, 137
Clay, 48, 49 60 61, 485
Clay belt of Canada, 376
Cleveland Hills, 399, 407
Clothing, 291
Clover, 161, 163, 164
Cloves, 424, 643
Clyde Valley, 401, 407
Coachella Valley, 196
Coal, 3, 23, 102, 325, 326, 351, 476
  Alaska, 364
  anthracite, 103, 104, 105, 108, 400, 606
    markets for, 108
  Australia, 653-654
  Belgium, 476
  bituminous, 103-108
  British Isles, 399-401
  British South Africa, 415
  by-products of, 104, (*charts*) 125, 126, 127, 276
    markets for, 127
  Canada, 380
  Chile, 674
  China, 605-606
  classes of, 103
  France, 433
  Germany, 499, 503-504
  India, 624
  Japan, 589
  Manchukuo, 598
  Netherlands 480
  Norway, cost in, 491
  Poland, 518-519
  semianthracite, 103, 104, 108
  semibituminous, 103, 105, 364
  subbituminous, 103, 105
  U.S.S.R., 574-575

Coal (*Cont.*):
United States, 104-108
declining use of, 102, (*charts*) 104, 125
fields, (*map*) 105
producing areas, 105–108
production by states, (*chart*) 107
reserves, (*charts*) 102, 105, 106
uses of, (*chart*) 103
Coal tar, 333-334
Coastal plain, 13
Cobalt, 70, 381
district, 381
Coca:
leaves, 686, 687
plant, 681, 686-687
Cocaine, 687
Cocoa, 420
Coconut oil, 641, 642, 735
Coconuts, 641, 743, 747, (*photo*) tree, 641
East Indies, 641-642
Philippines, 641-642
West Indies, 735
Cocoons, silk, 591, 592
Cod, 132, 133, 137, 138, 383, 433, 492, (*photo*) 138
Coeur d'Alene, 79, 81
Coffee, 424, 472, 658, 681, 687, 688, 723, 757
Blue Mountain, 734
Brazil, 713-715, (*photo*) 714
Central America, 745-746
Coban, 746
Colombia, 726-727
imports to U. S., (*chart*) 745
Mocha, 563
Venezuela, 725
Vera Pas, 746
West Indies, 734-735
Coir, 735
Coke, 104, 279, 329
Cole, G. D. H., 409
Colombia, 726-727
bananas, 727
coffee, 726-727
foreign commerce, 727, (*chart*) 727
minerals, 726
seaports, 727
Colombo, 631
Colon, 749
Colonos, 734
Columbia River, 135
Columbia River Gorge, 15
Combing, 298
Commercial pursuits, 27
Commodity rates, 311
Communication, 1, 4
Comparative advantage, principle of, 315
Comparative crop yields, 506
Complex manufactures, 23, 374, 388
Concrete, 38, 50
Condensed milk, 320, 322, 482, 531
Coniferous trees, 32, 376, 423, 490, 574, 623, 753
Connecticut wrapper tobacco, 231, 232
Connelsville basin, 107
Conservation:
of forests, 36
turpentine trees, 43
Contra Costa County, 205
Contract labor law, 638
Coolgardie 652
Cooperage, 34
Coöperative marketing:
allspice, 737
Baltic States, 525
British Isles, 402
Canada, 385, 388
Finland, 523
United States:
avocados, 197
eggs, 272
fruit, 189, 194, 197
nuts, 203, 211
vegetables, 175
Cooperite, 68
Copal, 478
Copenhagen, 474, 486
location, 485-486
Copper, 18, 38, 74-78, 341, 379, 380
Belgian Congo, 478-479
blister, 76
Chile, 675
China, 607
Japan, 589
markets for, 77
matte, 76
Mexico, 754, 755
refining, 76-77
smelting, 76-77
by products of, 95
U. S. S. R., 575
United States, 74-78
production by states, (*chart*) 75
uses, 75
Copra, 641, 642, 735
Coral, 367, 729, 730
Cordillera Real Range, 685
Cork (Ireland), 403
Cork oak, 453
Cormorant, 613
Corn, 313, 314, 455, 757
Argentina, 695-696
by-products of, 146, 163
Danube countries, 545, 546, 547, (*chart*) 543
natural requirements, 142-143
Spain, 455
sugar content, 213, 223
U.S.S.R., 577
United States, 141-146
importance, 141
regions of production, 143-145
uses, 141-142, (*chart*) 142
Corn belt, 22, 259, 263, 322
cattle feeding, 257, 258
future of, 145-146
Corn-hog ratio, 142
Corn Island, 742
Cornwall district (Pa.), 65
Cornwall Peninsula, 403, 408
Cor-Ten, 72
Corumbá, 687, 717
Costa Rica, 741, 743, 745, 746, 747, 749
Cotton, 39, 416, 599, 705, 758
Anglo-Egyptian Sudan, 427
Brazil, 713
British East Africa, 423-424
Egypt, 557
gins, 243
India, 627
Indo-China, 644
linters, 237, 246

Cotton (*Cont.*):
markets for, 237, 247
natural requirements, 238-240
Nigeria, 421 422
Paraguay, 706
Peru 680
U S.S R , 578
United States, 236, 237-248
importance, 237
manufacture of, 245 246, 293-298
methods of growing, 241 243
picking, (*photo*) 242
types, 239
uses, 236 237
world production, (*chart*) 248
Cotton belt, 22, 257 238, (*map*) 238
beef cattle, 258
credit system, 166, 245
draft animals, 268
hay and forage crops, 166 167
landholding system, 245
one crop system, 243 245
price control system for, 246-247
sheep, 265
Cottonseed, 237, 245
cake, 246
oil, 247
Cowpeas, 167
Crackers, 314
Cracking process, 117, 118, 127
Cranberries, 200 201
Creameries, 321
Credit system of southern States, 166, 245
Creosote, 35
Crepe, 300
Crimea, 579
Cristobal, 749
Crucible process, 281, 282
Crushed stone, 50
Cryolite 486
Cuba, 219, 220, 728 731, 735, 736, 737
Cup and gutter system, 43
Cuprammonium process, 303
Curaçao, 725
Currants, 119, 200, 657
Greece, 549, 550
Cyanamide process, 91
Cyanide process, 84

D

Dairy products in U S 256, 259 262, 307
location of manufacture, 320 322
products made, 320, 322
Dairying, 366, 676, 699
Australia, 657
Baltic States, 525
British Isles, 403
Denmark, 484
efficiency of, 259
Germany, 508
Netherlands, 481
New England, 3
New Zealand, 664 665
requirements for, 259
U.S S R , 579
United States·
regions of production, 261-262
types of industry, 260-261
Dakar, 446, 718
Daimatian coast, 540, 548
Dal River, 495, 497
Damascus, 559
Damask rose, 547
Danube River, 542, 546, 548
valley, 502
Danzig, 520
Dates, 195, 196, 445, 456, 562
Daule River, 688
Dead Sea, 558, 559
Deccan upland, 624
Decentralization of industry, 349
de Chardonnet, 302
Delaware River, 343
Denmark, 483 486
agriculture, 484 485
foreign commerce 485 486
geographic features, 483 484, (*map*) 483
manufacture 485
Detroit, 46, 341
Dewberries, 199 200 201, (*photo*) 199
Diamond cutting, 477, 481, 482
Diamonds 460
Belgian Congo, 479
Brazil 711
Southwest Africa, 415
Union of South Africa, 414
Diesel motor, 338
Dijon, 431, 439
Dimension stone
finishing, 51
New England 52
qualities, 50
types of operations, 51
Dinaric Alps 540
Dirigible, 123, 342
Distillation
dura 426
molasses 90
turpentine, 44
Dnieper River, 568, 570
Dobrudja, 545
Dogger Banks, 399
Dolomite, 48
Dominica, 736
Dominican Republic, 734, 735
Donetz basin, 574, 580, 581
Douglas fir, 18, 379
Douro River, 451, 455
Draft animals, 268-270
Drakensberg Mountains, 412
Drawing machines, 299, (*photo*) 294
Dresden china, 510
Drought·
Argentina, 697
Australia, 656
U.S.S R., 567
Drugs, 85
plants for, 46
Drying fruit, Australia, 658, (*photo*) 658
Drying fruits and vegetables in U. S., 307, 318
Duluth, 277, 288
Du Pont family, 320
Dura, 426, 558
Durango, 760
Durban, 415, 416, 419, 494
Durum wheat, 148
Dutch Harbor, 363
Dyeing textiles, 293, 303, (*photo*) 297

Dyes, 90, 333
Dykes, 479, 480
Dysentery, 666

E

East Indies, 632, 634, (*map*) 633
East St. Louis, 81, 83, 723
Eastern Ghats Mountains, 621
Eastern Sierra Madre Range, 752
Ebro Valley, 452
Economic activity, distribution in U. S., 26-29
Economic factors in.
agriculture, 22
chemical industry, 324, 327
dairying, 259
distribution of beef cattle, 256-257
fruit production 188, 196, 201
hay and forage production, 161
industrial activity, 1
market gardening, 173
nut production, 203-204
poultry production, 270, 271
sugar beet production, 215, 216
sugar cane production, 217, 218
swine production, 262
textile manufacture, 291
tobacco manufacture, 232-233
wearing apparel manufacture of, 304
Economic nationalism 402, 441, 767-768
and small empire countries 487
and the United States, 768-772
Ecuador, 687-690
crops, 688-689
foreign commerce, 690, (*chart*) 689
geographic features, 687
ivory nuts, 689
minerals, 687-688
Panama hats 689-690
transportation, 690
Edaphic factors, 22
Edison, Thomas A., 348
Edwards Plateau, 254, 265
Eggs, production in U. S., (*map*) 272
Egypt, 412, 554, 555-558
crops, 557
foreign commerce, 557
irrigation, 556-557
Elba, 465
Elbe Valley, 536, 537
Electrical equipment:
Germany, 511
Switzerland, 532
United States, 354-355
Electrical industry, 74, 85, 92
organization of, in U. S., 353
Electric furnace, 281, 282, 329
Electricity, 99, 104, 348, 391, 434, 504
advantages of, 349
consumption of, in U. S., 348-349
disadvantages of, 349
regional distribution in U. S., 348
transmission, 98
Electrochemical manufactures, 327, 328-329, 390, 494
Electrolysis, 328
Electrometallurgical manufactures, 327, 494
Elephants, 624, 629
El Salvador, 741, 743, 746, 747, 748, 749
Embroidery work, 532
Emeralds, 726
Emery, 561
Engines
internal-combustion, 99, 100
steam, 98, 100
Ensilage, 163, 164, 181, 319
Entrepot centers and trade, 411, 474, 631-644, 740
Equipment
aircraft, 342-343
automotive, 339-342
electrical, 354-355
railway, 338-339
ships, 343-346
Erie Canal, 3
Eritrea, 470, 471, 472
Erzberg, 503
manufactures, 510
Eskimos, 486
Esparto grass, 457, 458
***Estancias*, 697, 699**
Estonia, 516, 524-525-526
Ethiopia, 470, 472, 555
Eucalyptus, 651
Europe, 7
central plain, 475
Evaporated milk, 320, 322, 482
Exchange of products, 374, 399, 763
Explosives, 86, 90, 333
Extractive industries, 6

F

Fall Line, 13, 295
Farm land, value of, (*map*) 244
Farm woodlot, 36
***Fazenda*, 714, 715**
Feldspar, 48, 59, 92
Felt, 299
Fermentation.
tea, 628
tobacco 228-229
Fernando Po, 459
Ferro alloy minerals, 63-73, 85
Ferro manganese, 67
Ferro silicon, 67
Fertilizer, 55, 209, 219, 309, 320, 326, 367
cotton production, 243
tobacco production, 226
vegetable production, 174, 177
Fertilizer minerals, 86-91
functions, 87-88
importance, 86-87
Field beans, 161, 181
Figs, 195, 196, 318
Filatures, 591, 592
Filberts, 203, 206, 212
Film, 334, (*chart*) 335
Finger Lakes, 198
Finishing:
dimension stone, 51
industries of New Jersey, 292
steel, 284
textiles, 293, 294, 299
Finland, 521-523
agriculture, 523
foreign commerce, 523
geographic features, 521, (*map*) 522
manufactures, 523
natural resources, 521

Finlay, J. R., 79
Fiorded coasts, 378, (*photo*) 383, 489, 492, 663, 678
Fir, 495, 503, 542, 573, 588, 598
Fire clay, 60
Fire cure for tobacco, 227-228, 231
Fish:
  consumption, per capita, 131
  filleted, 133
  from U. S. forest streams, 30
Fisheries (*See also* fisheries *under the various countries*), 6, 30, 434, 443, 454, 484, 487, 521, 523
  Alaska, 364
  British Isles, 398-399
  Canada, 382-383, (*photos*) 382, 383
    markets for, 383
  France, 434
  Japan, 589-590
  location of, 131-132
  Newfoundland, 382
  Norway, 492-494
  political effects of, 130
  United States, 132-139
  value of products, 130
Flax, 39, 599
  Argentina, 696
  Baltic States, 526
  Belgium, 476
  Poland, 519
  U. S. S. R., 577-578
Fleece, 252
Flint Hills, 258
Flood-:
  China, 603, 604
  United States:
    control of, 35
    cost of, 31
Flotation process, 88, 651
Flounder, 132
Flour milling, 307, 311-313
Flower bulbs, 480, 740
Flue cure for tobacco, 228
Food manufactures (*See also* Canning industry in U. S.).
  British Isles, 408-409
  France, 439-440
  Spain, 457
  United States, 307-323
Ford Motor Company, 184
Foreign commerce (*See also* foreign commerce *under the various countries*):
  advantages of, 766-767
  aid for by government, 766
  basis of, 765-766
Forest products, exporting countries, (*chart*) 496
Forest wild plant industries, 45-46
Forests:
  Alaska, 363
  Brazil, 710-711
  Canada, 378-379
  Europe, southeastern, 542-543
  Finland, 521
  Germany, 503
  India, 623-624
  industrial functions of, 30
  Norway, 491
  Sweden, 495-496
Forests (*Cont.*):
  U.S.S.R., 573-574
  United States, 6, 14, 15
    and land utilization, 37
    conservation problems, 33
    fires, 33, (*photo*) 34
    ownership, 37
    regions, 15-18, (*map*) 15
    taxation of, 37
    uses in chemical industry, 326
    waste in utilization, 33, (*chart*) 35
Ft. Churchill, 394, (*photo*) 394
Fourdrinier machine, 39
France.
  agriculture, 435-438
  animal industries, 438
  climate, 432
  crops, 435-437, (*chart*) 436
  fisheries, 434
  foreign commerce, 440-441
  forests, 432
  geographic features, 430, (*map*) 431
  grape growing industry, 437
  manufactures, 438-440
  minerals, 433-434
  people, 430
  possessions in Africa, 441-442, 448-449, (*map*) 447
  reasons for importance, 429
  seaports, 440
  wine industry, 437, (*map*) 437
Free trade, 410
Freight rates, 1, 22, 60, 105, 118, 190, 232, 233, 287, 288, 301, 305, 311, 385, 759
  Canada, 385, 386, 391
  clay products, 61
  flour milling in U. S., 312-313
  meat packing, 311
  silk, 301
  tobacco manufactures, 232, 233
  wearing apparel, 305
  wheat, export, 158-159
French Equatorial Africa, 448
French Indo-China, 632, 636, 637, 640, 644
French West Africa, 446
Fresno, 198
Frigorifico, 700, 704
Frijoles, 181, 757
Frost drainage, 186
Fruit crops.
  Argentina, 696
  Australia, 658-659
  British Isles, 403
  British South Africa, 416
  Bulgaria, 546
  Canada, 386-387
  Chile, 676
  China, 610
  economic factors in production, 188-189
  Ecuador, 689
  Germany, 507
  Hungary, 544
  Iberian Peninsula, 455-456
  importance, 185
  Italy, 468
  juices, 315
  natural requirements, 185-187
  Rumania, 545
  types, 185

Fruit crops (*Cont.*):
U.S.S.R., 578-579
United States, 185-202
future of, 202
markets, 188, 201-202
natural conditions in California, 187-188
uses, 85
West Indies, 735-736
Fuel oil, 112
Fuller's earth, 61
Fungus diseases:
control of, 188
grapes, 198
Fur farms, 383, (*photo*) 384
Furniture in U. S., 41-42
centers of manufacture, 41
classes of, 41
Furs:
Alaska, 364
Canada, 383-384
Manchukuo, 598
seal, 139
U.S.S.R., 574

G

Gainfully employed in U. S., (*chart*) 26
Galapagos Islands, 687
Galatz, 542, 545-546
Galicia, 453
Galvanized iron, 38
Game animals, 30
Ganges River, 621
valley, 625, 626, 630
Garapata, 747
Gasoline, 112, 123
Gdynia, 520
Genetic industries, 6
Genoa, 469, 470
German Reich, 89, 90
agriculture, 506, 508
animal industries, 508-509
climate, 502
crops, 506-508, (*chart*) 508
economic problems, 514-515
factors in development, 499-500
foreign commerce, 513-514, (*chart*) 514
forests, 503
geographic features, 500-502, (*map*) 501
manufactures, 509-512
minerals, 503-504
natural regions, 500
people, 499-500
seaports, 512, 513-514
waterways, 512-513
Gezira plain, 426
Giant power, 355-357
Gila River valley, 15
Ginger, 643, 737
Ginseng, 46, 599
Glaciers and glaciation, 2, 14, 49, 124, 131, 155, 163, 362, 376, 381, 398, 479, 481, 483, 488, 500, 501, 521, 525, 530
Glasgow, 401, 407
Glass, 59, 62, 90, 333
Gliadin, 146
Glommen Valley, 494
Glutenin, 146
Goats:
Angora:
British South Africa, 417
Turkey, 561
United States, 253, 267
Argentina, 699
Brazil, 716
British South Africa, 417
Mexican, 254
Gobi, Desert of, 616
Gold (*See also* gold *under the various other countries*), 74, 83, 86, 379, 380, 422, 635, 711, 726
Australia, 652
U.S.S.R., 575
Union of South Africa, 414
United States, 85
Gold Coast, 421
Gooseberries, 199, 200
Gota River, 497
Göteborg, 497, 498
Goulborn Valley, 659
Government, 1, 31, 38
power program of U. S., 357-359
allocation of costs, 358-359
projects, (*map*) 358
Goyaz, 711
Gradual reduction process, 311, 545
Grand Bank, 133, 134, 434
Grand Falls, 392
Granite, 47, 49, 50, 51-53
uses of, in U. S., (*chart*) 52
Grapefruit, 194, 195, 706, 736
Grapes, 444, 549, 658, 681, 704
Argentina, 696-697
Australia, 658
France, 437, (*map*) 437
Hungary, 544
Iberian Peninsula, 456
Italy, 468
United States, 197-198
Graphite, 74, 92, 448, 486, 535
artificial, 93
Grasse, 440
Gravel, 49
and sand, 58
Gray cloth, 294
Great Basin, 69
Great Dividing Range, 649
Great Falls, 77, 81, 84
Great Lakes, 158
fisheries, 133, 136
location, 14
lumber region, 16
mineral region, 18
Great Plains, 265, 378
Great Salt Lake, 96
Great Wall of China, 603, 616
Greece, 549-550
agriculture, 549-550
exports, 550
manufactures, 550
seaports, 550
Green Banks, 133, 134
Greenhouses, 174
Greenland, 486
Guadalquivir River, 453, 458
valley, 451, 452, 454, 456
Guadeloupe, 729

Guam, 360, 370
Guano, 89, 679, 680
Guatemala, 741, 743, 745, 746, 748, 749
Guayaquil, 690
Guayaquil-Quito Railway, 690
Guayule, 757
Guiana highlands, 668, 722 723
Guianas, the, 721-723
  geographic features, 721, 723
  foreign commerce, 723
  natural resources and industries, 723
Gulf of Bothnia 497, 498
Gulf of Guinea region, economic advantages, 420
Gulf plain of U S , 19
Gulf Stream, 133, 765
Gumbo, 61
Gur, 627
Gypsum, 61, 95

H

Hay-making, 751
Hallock 132 133, 137
Hamp 734, 738
Halibut 132 137 135, 138, 382
Halifax, 304
Hamburg, 513 514
Hand of tobacco, 234
Hankow, 604, 606, 610
Harbin, 595
Harbors
  Atlantic coastal plain, 13
  Australia 662
  Bermudas 740
  British Isles, 397
  Cuba, 740
  France, 440
  India, 662
  Japan, 584
  Norway, 492
  U S S R , 570
  West Indies, 740
Hardwoods, 15, 16, 31 338, 379, 421, 518, 574, 651, 693, 710
Harz Mountains 503 504, 510
Hasa Oasis, 563
Hatchery business 271
Hawaii, 219, 220, 360, 367-369
  cane sugar, 367 368
  features, 367
  foreign commerce, 369
  pineapples, 368-369
  people, 367
Hay and forage, 161 169, 259, 269, 320, 386
  advantages in growing, 161
  Canada, 386
  France, 435
  Norway, 494
  relative importance, 162
  U S , regions of, 162-168
    distribution, 161-162
    grain belt, 163 166
    northeastern dairy region, 163
    southern States, 166 167
    West, 167, 169
Helium, 123
Helsinki, 524
Hematite, 64
Hemlock, 15, 40, 44, 363, 379
Hemp:
  China, 611
  Italy, 468
  Manila, 643 644
  for paper, 41
  plants, (*photo*) 249
  U S S R 577 578
  United States, 248-250
Henequen 757 758
Herring, 132, 135, 137, 138, 433, 492, 590
Hickory nuts, 203, 207
Hides and skins, 44, 256, 309, 410, 425, 447, 460, 471, 566, 629, 681, 682, 697, 699, 716, 747, 758
Himalaya Mountains, 620 621, 622, 623, 629
Hindu m, 619
Hindustan 621
Hobart, 651, 653, 654, 660, 662
Holding companies, 354
Holy Land, 559
Home baking 313
Home industries 134 511, 532, 613
Home or hard 701
Homestake mine 85
Honduras , 741, 743, 745 746, 747, 748, 749
Honey 158 164, 218 221 223
  regions of production in U S , 222 223
  requirements 222
  uses in U S , 221 222
Honey locust, 207
Hong Kong 615, 645
Honolulu 367
Hookworm 666
Hops, 403, 507
Horsepower installed in U S , 99
Horses and mules, 268 270
  distribution in U S 268 269, (*map*) 269
Horses
  Arabian, 154, 563
  Persian, 564
Hosiery, silk, 302
Hothouse lambs, 267
Howland Island 360, 369
Hudson Bay 394
  open season for ships, 495
Hudson Bay Company, 384
Hudson Strait, 395
Hudson Valley, 191, 198
Hull-Rust Mine (*photo*) 65
Humboldt Current, 672, 679
Humidifiers 296
Hungary, 544-545
  agriculture, 544
  exports, 545
  manufactures, 545
Hurricanes, 730, 732, 735
Hwai Ho, 605
Hwang Ho, 603
Hydrochloric acid, 96, 330
Hydroelectric energy, 81, 83, 91, 102, 295, 328, 418, 434, 530, 589, 629, 654, 675, 679, 685, 700
Hydroelectric plants, 350, 353, 356
  costs, 102, 352
  efficiency, 352
  location, 351
Hydrogen, 123
Hydrogenation process, 119, 126, 127

I

Iberian Peninsula:
  agriculture, 455-457
  animal industries, 457
  climate, 452-453
  crops, 455-457
  fisheries, 454
  foreign commerce, 458
  forests, 453
  geographic features, 450-452, (*map*) 451
  manufactures, 457
  minerals, 453-454
  retarding factors, 450, 452
  seaports, 458
Icebergs, 486, 765
Icecaps, 486
Ice cream, 204, 320, (*chart*) 322
Iceland, 486-487
Ifni, 459
Ignassu Great Falls of, 700
Illinois coal field, 80, 108
Imatra rapids, 521
Imperial Valley, 175, 176, 196, 758
Income distribution in U. S., (*chart*) 27
India, peninsular, 621
Indian, American, 255, 667, 682, 691, 741, 751
Indian Empire
  agriculture, 625-629
  animal industries, 629
  climate, 622-623
  crops, 625-628
  economic problems, 631
  foreign commerce, 630-631, (*chart*) 630
  forests, 623-624
  geographic features, 619-622, (*map*) 620
  manufactures, 629-630
  minerals, 624
  natural regions, 619
  people, 619
  seaports, 622-631
  seasons, 622
  tea, 627-628
Indo China, 622, 632, 634
Indus River valley, 621
Industrial activities
  distribution in U. S., 15-19
  and transportation, 2
Industrial Revolution, 98
Ingots
  molds, 284
  pouring, (*photo*) 283
  rolling, (*photo*) 284
Inn River, 542
Integration:
  chemical manufacture, 328
  power development program, 357
  steel manufacture, 285, 288
  transportation equipment, manufacture of, 337
Interchangeable parts, 340
Interconnection of power companies, 99, 350, 354, 355, 356
Interdependence of nations, 373
Internal combustion motors, 99
  advantages for industrial power, 353
Investment, 151, 286, 728
  Alaska:
    fisheries, 364
    fur farms, 364
Investment (*Cont.*):
  Argentina wine industry, 697
  British, in, 410, 465
    Argentina, 701-702
    Iraq, 562
    Mexico, 760
    Paraguay, 706, 707
    Uruguay, 704
  cane sugar industry, 217
  Canada fur farms, 383
  Central America, 749
  chemical industry, 325, 328
  Chile wine industry, 676
  electrical generating industry, 349
  electrical industry, 354
  fisheries at Los Angeles, 136
  foreign in
    China, 613
    Mexico, 755
  France, 440
  French West Africa, 442
  highways and railways in U. S., 339
  hydroelectric plants, 128, 352
  Iberian Peninsula, 450
  iron and steel industry, 275, 286
  nut production, 204
  petroleum pipe lines, 119
  quebracho corporations, 751
  silk throwing, 300
  steam plants, 352
  sugar beet refinery, 216
  Sweden, foreign, 498
  Swiss hotels, 533
  transportation equipment, 337
  United States, in
    Brazil, 711
    Canada, 392
    Cuba, (*chart*) 730
    Mexico, 755
    mineral supplies, foreign, 19, 72
    Paraguay, 706
    Philippines, 638, 642, 646
    South America, 666
  whaling industry, 493
Invisible exports, 410
  of British, 411
Iquitos, 719
Iran, 564-565
  crops, 564
  foreign commerce, 565
  geographic features, 564
  industries, 564-565
Iraq, 562-563
  foreign commerce, 563
  natural resources, 562
Irbit, 574
Ireland, 398, 403
Ireland Island harbor, 740
Irish Free State, 396
Irkutsk basin, 575
Iron:
  desirable qualities, 63
  galvanized, 38
  uses, 63
Iron and steel:
  Australia, 660
  British Isles, 406-408
  by-products of, 286, 288, 289
  Canada, 380
  China, 613-614

Iron and steel (*Cont.*):
France, 435
Germany, 510, 511, 512
India, 630
Italy, 469
Japan, 594
U.S.S.R., 580
United States:
consumption, (*chart*) 275
divisions of industry, 275-276
finishing operations, 284
location of mills, 286-289, (*map*) 286
markets for, 276
organization of industry, 285
principles of manufacture, 283-284
rise of industry, 274
stages in manufacture, 278-284
Iron and Steel Institute, 284
Iron Gate, 538, 540
Iron Knob, 654
Iron ore, 1, 18, 279, 288, 341, 760
Algeria, 443
Brazil, 711
British Isles, 396, 399
Canada, 380
Chile, 675
China, 606
Cuba, 731
France, 433-434
geological formation, 64
Manchukuo, 599
oxide ores, 279
preparing for manufacture, 276
reserves, 66
smelting, 279
Spain, 454
Sweden, 497
types, 64
U.S.S.R., 574, 575
United States, 63-66
centers of production, 64-65
Lake Superior district, 64, 65, 66
pier, (*photo*) 277
reserves, 66
transportation, 276-278
Irrawaddy River, 622, 626
Irrigation, 29, 194, 222, 265, 357, 386
Anglo-Egyptian Sudan, 426, 427
Argentina, 696, 698
Atlas countries, 442, 443
Australia, 650, 654, 659, 661
British South Africa, 416
Egypt, 556-557
Greece, 549
Hawaii, 367
India, 625, 626, 627, 631
Iran, 564
Iraq, 562, 563
Mexico, 756, 757, 758, 761
Palestine, 558
Peru, 679, 680, 681
Spain, 456
Turkey, 561
United States, 167
fruit, California, 187-188, 193
fruit, Washington, 190
sugar beets, 216
sugar cane, 217
Irtysk Valley, 575
Island republics and colonies:
climate, 730-731
crops, 731-738
factors in progress, 728
fisheries, 731
foreign commerce, 738-740, (*charts*) 739
geographic features, 729-730
map, 729
minerals, 731
people, 728
seaports, 739
sugar cane, 731-734
Isle of Jersey, 260
Isle of Man, 396
Isle of Pines, 735, 736
Istanbul, 550, 552, 562
Itabira, 711
Italian East Africa, 470
Italy, 89
African possessions, 470-473
agriculture, 467-468
animal industries, 468
climate, 465, (*chart*) 465
crops, 467-468, (*chart*) 467
factors in development, 462-463
foreign commerce, 470, (*chart*) 470
geographic features, 464-465, (*map*) 463
manufactures, 468-470
minerals, 466
people, 464
seaports, 470
Ivigtut, 486
Ivory, 448, 478
nuts, 689
vegetable, 689
Ixtle, 758
Izett, 72

J

Jaffa, 558
Japanese Current, 363
Japanese Empire
agriculture, 590-593
climate, 586-588, (*map*) 587
crops, 590-593
divisions, 584, (*map*) 585
factors in progress, 584-586
fisheries, 589-590
foreign commerce, 595-596, (*chart*) 595
forests, 588-589
geographic features, 586-588
manufactures, 593-595
minerals, 589
people, 584, 585
seaports, 595-596
silk industry, 591-593
Japanese Sea, 587
Jamaica, 728, 734, 735, 736, 737, 740
James Bay, 376
Jamshedpur, 624, 630
Jarrah, 651
Jarvis Island, 360, 369
Java, 632, 635, 636, 637, 638
Jefferson County, Ala., 64
Jewish Colonization Association, 695
Johannesburg, 415
Johnson grass, 167
Jones-Costigan Act, 220
Jordan River, 558

Judea, 558
Jujuy district, 696, 697
Jumnia River, 621
Juneau, 363
Junin, Department of, 679
Juras, 530, 532
Jute, 627, 630
Jutland, 485

K

Kaffa, 472
Kaffir corn, 165, (*photo*) 166, 416
Kaietawe Falls, 721
Kalahari Desert, 413
Kalgan, 616
Kanawha Valley, 328, 333
Kansas City, 311, 312
Kaoliang, 599
Kaolin, 48, 60, 408, 489, 607
Karachi, 631
Karafuto, 588
Karakoram Pass, 620
Karra, 651
Kashgar, 617
Kashmir, 620, 630
Kassala Railway, 427
Katanga district, 415, 416, 419, 460, 478
Kenya, 422, 423, 424
Kerosene, 112
Khartoum, 425, 427, 479, 555, 556
Kherson, 575, 583
Khyber Pass, 566, 620
Kiatka, 616
Kiel Canal, 485
Kimberley, 414
Kingston, 740
Klodnitz basin, 519
Knitting, 293, 294, 297, 298, 299, 302
Kobe, 595, 596
Kootenay district, 380, 381, 387
Kure Island, 360, 369
Kurile Islands, 583
Kuznetsk basin, 575, 580, 581
Kwen Lun Mountains, 617
Kyoto, 594

L

La Guaira, 726
La Plata, 693, 703
Labor, 1, 3, 5, 22, 24, (*chart*) 26, 29, 392
Labor:
  automotive manufacture, 340, 341
  bakery products, 314
  Brazilian coffee industry, 714
  British fisheries, 399
  canning industry, 317
  chemical industry, 324, 325
  cotton growing, 243
  dairying, 259
  flour milling, 312
  food manufacture, 307
  iron and steel, 275, 285
  meat packing 310
  petroleum production, 119
  pineapple industry, 369
  poultry industry, 271
  rayon manufacture, 304
  shipbuilding, 346
  silk manufacture, 301, 302
Labor (*Cont.*):
  sugar beet industry, 215
  sugar cane industry, 218, 219, 368
  textile manufacture, 292
  U.S.S.R., 573, 578
  vegetable growing, 173
  wearing apparel, manufacture, 305, 306
Labrador Current, 765
Labuan, 636
Lac, 624
Lace, 477
Lacquer, 333, 334
Laguna district, 758
Lake Chad, 422
Lake Maracaibo, 724, 725, 726, 729
Lake Nahuelhuapi, 702
Lake St. John, 390, 392, 723
Lake Superior iron ore district, 64, 65, 66
Lake Titicaca, 687
Lancashire, 401, 404
Land, submarginal, 38
Land utilization, 37
Landholding system of cotton belt, 245
Lapis lazuli, 566
Larch, 495, 573, 588, 598
Lard, 273
Laredo, 760
Large estates, 481, 485, 506, 519, 525, 545, 667, 751
  Argentina, 694-695
  economic advantages, 544
  Mexico, 756
  South America, 667
Laterite soil, 621
Latin America, 7, 114, 135, 333, 666
Latvia, 516, 524, 525, 526
Laurentian upland, 376, 377, 392, 521
Lava soil, 148, 621
Lead, 18, 74, 78-80, 84, 86, 380, 381, 454, 652, 754
Leather.
  artificial, 334
  tanning, 45
Leather goods, manufacture of:
  Bohemia, 536
  British Isles, 408
  British South Africa, 419
  Chile, 677
  France, 439
  Germany, 511
  India, 630
  Mexico, 760
  Poland, 519
  Spain, 458
  U.S.S.R., 580
  Uruguay, 704
Leeward Islands, 729
Leghorn, 469, 470
Legumes, 90, 162, 167, 209
Lehigh district, 58
Leith, Charles K., 48
Lemons, 195, 455, 468
Leningrad, 570, 583
Leopoldville, 479
Lespedeza, 167
Lesser Antilles, 729
Levulose, 221
Liao Ho Valley, 598, 599
Liaoling Peninsula, 599

Liberia, 7, 412
Libya, 470, 471
Licorice, 560
Lignite, 103, 364, 606, 623, 653
  Australia, 653
  China, 606
  Germany, 504
  United States, (*chart*) 105
Limburg, 480
Lime, 50, 55, 320, 326, 335
  hydrated, 330
  in diet, 203
  slaked, 332
Limes, 195, 736
Limestone, 48, 49, 50, 54 55, 279, 283, 326, 329, 330, 758
  areas in U. S., (*map*) 54
  uses in U. S., 53
Limoges china, 439
Limonite, 64
Linen, 39, 406, 439, 477
Liquors, intoxicating, 142, 154, 157, 160, 408, 409, 520
  aging of, 84
Lisbon, 458
Lithosphere, 48, 63
Lithuania, 516, 524, 525, 526
Liverpool, 405, 411
Llama, 682, (*photo*) 682
Load factor, 356
Lobster, 132, 133, 135, 382, 383
Locomotives, 407
  electric, 338
  steam, 338 (*photo*) 339
Lodz, 519
Loess soil, 187, 576, 603, (*photo*) 604
Lofoten Islands, 492
Loganberries, 201
Logwood, 743
London, growth of, 409, 411
Lourenço Marques, 419, 460
Lower California, 752
Luana Valley, 415
Lubricants, 112, 115, 127
Lumber, 6, 341
  substitutes for, 38
Lumber in the United States:
  consumption, 39
  milling, 38
  price, 32
  proportion supplied by various species of trees, (*chart*) 31
  regions, 14-17
  transportation cost, 32
  used in manufacture, 32
Lumbering, 29
  India, 624
  Norway, 491
  regions of U. S., 14-17, (*map*) 15
  Sweden, 495
Lyon, 439

M

Mace, 737
Macedonia, 549
Machine industry, 5, 24
Machinery
  agriculture, 22, 29, 145
Machinery (*Cont.*):
  bakery products, 314
  canneries, 316
  copper mining, 76
  cotton growing, 241
  peanut production, 210
  quarrying, 50, 51
  shelling nuts, 204
  shipbuilding, 346
  silk manufacture, 300
  sugar beet production, 216
  sugar cane production, 217, 218
  tobacco growing, 226 227
  tobacco manufacture, 233
  wheat growing, 148 149
Mackenzie River Valley, 380, 384
Mackerel, 132 133, 134 137 138, 434, 492, 500
Madagascar, 93, 448
Madeira Islands, 458
Madeira River, 710
Madras, 621, 624, 630, 631
Madrid, 452
Magallanes, 699
Magdalena Valley, 726, 727
Magnesite, 63 535
  Austria, 71
  U. S. S. R., 71
Magnetite, 64, 497
Maguey, 757
Mahogany, 742 743
Mail contracts, 344
Maimachen, 616
Malaria, 420, 464 643, 666
Malay Peninsula, 641 645
  rubber industry, 638 640
Manaos, 718 719
Manchester, 404
  ship canal, 404 405
Manchukuo, 584, 597 599
  agriculture, 599
  climate, 598
  control of, 597
  forests, 598
  geographic features, 598
  minerals, 598 599
  people, 597
Manganese, 19, 63, 67, 731
  Brazil, 711
  India, 624
  U. S. S. R., 575
Mangrove, 421, 423, 623
Manila, 645
Manioc, 637, 712
Manufacturing in the United States:
  annual income, (*chart*) 27
  distribution, 23-24
  employees, 22, (*chart*) 26
  leading industries, (*chart*) 23
  reasons for importance, 24
Maple sugar, 223
Maple syrup, 223, 754
Maracaibo, 725, 726
Marble, 38, 48, 49, 55 56
  Italy, 467
  uses in U. S., (*chart*) 56
Margarine, 309, 477, 481, 485
Maritime Provinces, 375
Maritsa Valley, 538, 546
Market gardening, 172, 173

Marketing:
advantages of large creameries, 321
bananas, 744-745
corn, 144
cotton, 248
fish, 137
forest wild plant leaves, 46
meats, 308
petroleum products, 119
vegetables, 173, 175
Marseille, 429, 439, 440
Mass production, 340, 347
Matanuska River Valley, 364, 366
Matidi, 479
Matté, 77
Matto Grosso, 711 715
McKenzie River, 723
McMurray district, 380
Meat, importance of, 255-256
Meat packing
Alaska 365
Argentina, 700
Brazil, 716
United States, 89, 307 311
by products, 308 310
centers, 310 311, (*map*) 309
history, 307-308
organization of industry, 308 309
organization of plant, 310
Uruguay, 704
Mecca, 561
Mechanical energy, 6
Medina, 564
Mediterranean type of climate, 432, 443, 452, 466, 540 650 657, 664
Melbourne, 650, 652, 653, 662
Memel, 526
Mendoza, 697
Menhaden, 132, 134, 135
Mennonite colony, 705
Mercerizing cotton, 294
Merchants 4
Mercury 19, 84, 85, 466
Mesabi Range, 64, 277
Meseta of Spain, 450, 452, 453, 466
Mestizos, 667, 741, 751
Mexico, 80, (*map*) 752
agriculture, 755 758
animal industries, 758
chicle, 754
climate, 753
crops, 757 758
foreign commerce, 761
forests, 753
future, 761 762
geographic features, 751-752
manufactures, 759 760
minerals, 754 755
people, 751
plan for economic development, 762
seaports, 761
transportation, 760 761
Mexico City, 751, 754, 760
Mica, 48, 74, 91, 448, 624, 743
Midcontinent oil province, 115
Middle latitude tree fruits in U. S., 189-190
Middlesborough, 407
Midway Island, 360, 370
Milan, 465. 469
Milk, 260, 261, 262
consumption in U. S., 259
elements, 259
Milk chocolate, 631
Millet, 599, 625
China, 608-609
India, 626
United States, 165-166
Milling quality of wheat, 148
Milo, 165
Minas Geraes, 711, 712, 716, 717, 719
Minasragra district, 679
Minerals (*See also* minerals *under the various other countries*), 6
Alaska, 363
Asia, southeastern, 634-636
Atlas countries, 442 443
Australia, 652-654
Belgian Congo, 478-479
Bolivia, 685
Brazil, 711
British Isles, 399 401
British South Africa, 413-415
Canada, 379-381
Chile, 674-675
China, 605-607
Colombia, 726
definition of, 47
Germany, 503-504
India, 624
metallic, 74
Mexico, 754-755
nonmetallic, 74, 86
Peru, 679
U S S R, 574 575
United States'
position, 19
regions, 18-19
Venezuela, 724
Mining in the United States, 29, 334
aluminum, 82
annual income, (*chart*) 27
coal, 109-112
long-wall method, 110, (*diagram*) 110
room-and-pillar method, 110, (*diagram*) 109
shaft, 109
steps, 111
iron ore, 64
people employed, (*chart*) 26
salt, 96
sulphur, 95, (*chart*) 94
Mississippi Delta, 219
Mississippi River, 158, 288
Mississippi Valley, 14, 30, 223, 308
Missouri River, 163, 311
Mistral, 432
Mixed-base oils, 114
Mohair, 253-254, 417, 561
Mohammedanism, 558, 564, 612, 619
Mohammerah, 565
Mohawk Gap, 14
Mohawk Valley, 295
Molasses, 731
by-products of, 90
Mollendo, 685, 687
Molybdenum, 63, 69
Mombasa, 424
Monazite, 711
Monel metal, 68

Mongolia, 615, 616
Monopoly, 328, 412, 486, 591
  diamond industry, 415
Monsoon:
  climate, 622-623
  rains, 623, 625
Monterrey, 755, 760
Montevideo, 704, 717
Montreal:
  advantages for manufacturing, 389, 390
  seaport, 392-393, 394
Montserrat, 735
Moors, 458
Morava Valley, 538, 550
Moravia, 528, 535, 536
Moravian gateway, 518, 520, 528, 538
Morocco:
  French, 442, 443
  Spanish, 459
Moscow, 567, 568, 570, 580
Mosul, 562
Moving picture industry, 84
Mozambique, 460, 461
Mukden, 599
Mulberry trees, 436, 468, 546, 560, 591, 592, (*photo*) 593
Mules, and horses, 268-270
Multiple-service projects, 357, 359
Munitions, 246, 536
Murman coast, 570
Murray River, 659, 661
  basin, 649
Muscadine grapes, 183, 198
Muscle Shoals, 91
Mustard gas, 333

N

Nagasaki, 596
Nagayo, 594
Nancy, 433, 439
  temperatures, (*chart*) 433
Naples, 469
Narva, 525, 526
Narvik, 495, 497
Nassau, 731, 736
Natal, 718, 719
Natural gas, 333, 350, 380
  by-products of, 123
Natural resources:
  United States, 11-23
  use of, 5
Naval stores:
  France, 432
  United States, 42-44
Near East, 554, (*map*) 555
  importance, 554, 556
Nectar, 222
Negroes, 237, 667, 691, 728, 741
Nejd, 563
Netherland India, 632, 636, 642, 643, 738
Netherland West Indies, 725-726
Netherlands, 89, 260, 479-483
  agriculture, 480-481
  colonial possessions, 482
  foreign commerce, 482
  geographic features, 479, (*map*) 475
  manufactures, 481
  minerals, 480
  seaports, 482
New Caledonia, 636
Newcastle (England), 408
Newcastle (N.S.W.), 653, 660
Newcastle (Union S. Africa), 415
New England, 2, 13, 15, 40, 101, 107, 108
  agriculture, 2
  factors in industrial development, 2-3
  fishing industry, 2, 133
  manufactures, 3
  textile industry, 292, 295, 296
Newfoundland, 375, (*footnote*) 375, 380
  fisheries, 382
  pulp and paper industry, 392
New Guinea, 634, 635
New South Wales, 649, 654, 656, 657, 659
Newsprint, 40, 334
New Zealand, 662-665
  climate, 664
  foreign commerce, 665
  geographic features, 662-663, (*map*) 663
  kauri gum, 665
  pastoral industries, 664-665
Niagara Falls, 83, 91, 93, 328, 333
Nicaragua, 741, 742, 743, 745, 746, 747, 748, 749
Nichrome, 68
Nickel, 1, 19, 63, 68, 79, 381, 636, 711
  by-products of (Canadian), 381
Niger Valley, 446
Nile River, 428, 555-556
Nitrate, 74, 85, 91
  manufacture in U. S., 91
  methods of manufacture, 91
  mineral, 90, 674-675
Nitric acid, 90, 329, 330, 334
Nitrocellulose, 334
Nitrogen, 90, 210
  effects on plants, 88
  sources of, 90
Nitro process, 303
Nomadic herding, 445, 471, 573, 579
Noranda, 381
North Atlantic Drift, 398, 489, 490
Northern Ireland, 396, 402
Northern Rhodesia, 413, 415, 416, 461
Northern Territory, Australia, 654
North Island, 662, 664
Norway, 491-493
  agriculture, 494
  fisheries, 492-494
  foreign commerce, 491, 495
  forests, 491
  manufactures, 484
  minerals, 491
  water power, 491-492
  whaling industry, 493-494
Nova Scotia, 380, 765
Nut crops, 203-212, (*chart*) 204
  outlook for, in U. S., 210-211
  problems of growing, 203-204
  regions of production in U. S., 204-205
Nutmeg, 643, 737
Nuts:
  importance, 203
  imports into U. S., 212
  qualities of, 203

O

Oak, 44, 503, 530, 542, 546, 547, 598
  cork, 453

Oases, 445-446, 616, 617, (*photo*) 445
Oats, 313, 314
  British Isles, 402
  natural requirements, 152-153
  qualities, 152
  types, 153
  U.S.S.R., 527
  United States, regions of production, 153-154, (*map*) 153
  uses, 151
Ocean routes, (*map*) 764
Odessa, 583
Oficina, 675
Ohio River Valley, 30, 107, 164, 172, 230
Oil palm, 421
Oilseeds:
  Anglo-Egyptian Sudan, 426
  China, 609
  India, 626-627
Oil shale, by products of, 121
Okanogan Valley, 387
Olive oil, 456, 458, 549, 550
Olives, 195, 444
  Italy, 468
  orchard, (*photo*) 443
  Spain, 455-456, (*map*) 456
  Tunis, 444
Omaha, 80, 311
One-crop agriculture, 243-245
Ontario, advantages for manufacturing, 389
Oolitic limestone, 55
Open-hearth process, 274, 280, 281, 282, (*photo*) 282
Open-pit mining, 50, 64, 82, 109, 504, 599
Opium poppy, 610-611, 612
Orange juice, 185, 193
Oranges, 194, 195, 689, 704
  bitter, 706
  Brazil, 712-713
  markets for, 192, 194
  navel, 193
  Palestine, 558
  Paraguay, 706
  round, 192, 194
  Satsuma, 192
  Spain, 455
  United States, 192-195
  Valencia, 193, 194, 455
  West Indies, 736
Orchard grass, 163
Organzine, 300
Orinoco basin, 725
Osaka, 594, 595
Oslo, 494
Oslo Fiord, 491
Ostrich raising, 417-418
Ottawa, advantages for manufacturing, 390
Ottawa River, 390
Otter trawl, 137
Overijssel, 482
Oxide ores, 75
Oysters, 132, 383, 434, 590
  pearl, 590
  United States, 133-134, 135, 138
Ozarks, 14, 17, 18, 198, 201, 288

P

Pachuca, 754
Pacific possessions of United States, 360, (*map*) 361, 367-370
Pacific possessions of United States (*Cont.*):
  advantages of ownership, 360-361
Pago Pago, 370
Palermo, 469
Palestine, 558-560
  foreign commerce, 559
  industries, 558
  natural resources, 558
  people, 558
  transportation, 559
Palisades, 54
Palm oil, British West Africa, 420, 421
Pampas, 693, 698, 703
Panama Canal, 394, 740, 752
  tolls, 670
Panama City, 749
Panama hats, 689-690
Panama Railway, 749
Panama, Republic of, 743, 745, 746, 747, 749
Paper, 39
  from hemp, 41
  importance, 39
  kraft, 40, 41
  other materials for, 41
  uses in U. S., 39
Papyrus, 425
Paraffin oils, 114
Paraná, State of, 711
Paraguay, 705-707
  backwardness, 705
  climate, 705
  foreign commerce, 707
  geographic features, 705
  industries, 705-706
  yerba maté, 706-707
Paraguay River, 685, 707
Paraná River, 693
Paris, 429, 430
Paris Basin, 430, 431, 432, 452
Pasteur, Louis, 315
Pastures, 169
Patagonia, 693, 700
Patents, 354
Paterson, 301
Peace River, 395
Peaches, 318
Peak load, 352
Peanut, 161, 167, 203, 209-210, 264, 421
  butter, 209, 210
    by-products of manufacture of, 210
  cake, 209
  French West Africa, 446
  oil, 209, 210
  stack, (*photo*) 211
  varieties, 209, 210
Pearl:
  diving for, 563, 652
  oysters in Japan, 590
Pears, 191
Pecans, 203, 205-206
Pemba, 424
Penang, 645
Pennines, 397, 400
Peons, 756
Pepper, 643, 737
Percheron horse, 269, 438
Perené district, 681
Perfumes, 440, 493, 706
Perique tobacco, 232
Pernambuco, State of, 713

Persian Gulf, 563
Persian walnuts, 205
Peru, 678-685
  agriculture, 679-680
  animal industries, 681-684
  crops, 680-681
  foreign commerce, 684-685
  geographic features, 678-679
  minerals, 679
  rivers, (*map*) 678
  seaports, 685
  transportation, 684
Peruvian balsam, 743
Peruvian full rough cotton, 680
Petitgrain oil, 706
Petroleum, 13, 19, 61, 100, 112, 333, 350, 380
  Bahrein Islands, 564
  Bolivia, 685 686
  by-products of, 118, 127
  classes, 113 114
  Colombia, 726
  East Indies, 635
  India, 624
  Iran, 565
  Iraq, 562
  Mexico 754 755
  occurrence underground, 113, (*chart*) 113
  Peru, 679
  U S S.R., 575
  United States
    centers of production, 114
    fields, (*map*) 115
    refined products (*chart*) 112
    refining methods, 117 118
    reserves, 114
  Venezuela, 724
Philippine Island, 219 220, 360, 632, 634, 635, 636, 638, 640, 642, 643
  and the United states 646 647
Phosphate rock, 13 88, 326 330, 636
  Atlas countries, 442 443
  reserves in U S., 88
Phosphorus, 74, 88, 319, 330
  effects on plants, 87
Photographic film, 83, (*photo*) 335
Physical environment, 1
Picric acid 334
Piedmont area, 13, 42, 101, 107, 230, 237, 295
Piedras Negras, 760
Piers for iron ore, 277, (*photo*) 277
Pig iron, 278, 280, 283
  casting machine, (*photo*) 281
  refining, 278
Pilchard, 135
Pimento, 737
Pinar del Rio, 737
Pindus Mountains, 540
Pine, 16, 379, 432, 453, 495, 500, 503, 518, 573, 598, 651, 674, 711
Pineapples:
  Hawaii, 368-369, (*photo*) plantation, 368
  Malay Peninsula, 644
  West Indies, 736
Pine nuts, 206
Piñon, 206
Pintos, 181
Pipe lines, for petroleum:
  Iran, 565
  Iraq, 562
  United States, 117, 119-120
Pistachio, 203, 206, 207, 212
Pitchblende, 381
Pittsburgh district, 107
  coal seam, 107
  iron ore, 65
Pittsburgh plus, 287, (*footnote*) 287
Placer deposits,
  gold and silver, 84
  platinum, 85
Placer mining, 84 363, 635, 711
Planing mills, 32, 33
Plankton, 131
Plant nutrients, losses, (*chart*) 87
Plantations, 424, 579, 636, 641, 643
  Brazil, 710
  rubber, 639-640, (*photo*) 640
  tea, 628
Plaster, 55, 61, 71
Plastics, 182, 183, 184, 334
Plata River system, 691, 693
Platinum, 19, 71, 85, 329, 415, 726
Plzen, 536
Poland, 516 520
  agriculture, 519
  climate, 518
  foreign commerce, 520
  forests, 518
  geographic features, 518, (*map*) 517
  historical factors, 516, 517
  manufactures, 519 520
  minerals 518 519
  natural regions, 518
  people, 516, 517
  seaports 520
Polders, 480
Political factors 1
Polymerization, 118
Porcupine district 380
Portland cement 61
Port of London Authority, 411
Port of Spain, 725
Port Sudan 427
Portugal, 450 459
  islands in Atlantic 458-459
Portuguese Africa, 459 461
  British interest in, 460
  divisions, 459
  importance, 460
  industries, 459
  resources, 459
Portuguese Guinea, 459, 460
Potash, 89, 90, 319, 326
  France, 434
  Germany, 499, 504
Potassium, 74, 89
  effects on plants, 87
  reserves of U S., 89
Potassium cyanide, 84
Potatoes, 403, 436, 437
  Australia, 658
  Germany, 506, 507
  natural requirements, 178
  Peru, 681
  qualities, 178
  U S.S R., 578
  United States, regions of production, 178-179
Pottery, 62, 482, 485, 498, 519, 595
  Bohemia, 536
Poultry, 271-273, 547
  China, 612-613

Poultry (*Cont.*):
efficiency, 270
influences determining location, 270-271
United States
backing, 272-273
regions of production, 271-272
types of industry, 271
Po Valley, 464, 467, 468, 469
Power.
draft, 255
industries, 6, 348 359
resources, 6, 373
Poznan Marshes, 518
Praha [Prague], 536
Prairie Provinces, 379, 382, 390
Precious metals, 77, 83-85
Pretoria, 414
Pribilof Islands, 130
Price.
control system for cotton, 246
stabilization, 315
Primary industries, 6
Priming of tobacco, 227
Primogeniture, 435
Prince Rupert, 394
Principe, 459, 460
Pripet Marshes, 518
Processing, 23, 408
Productive industries, 6
Protective tariffs, 1 214, 300, 344, 388, 389, 402, 618 647, 659
Prune plum
United States, 191 192, 318
Yugoslavia, 547
Public service, 29
annual income (*chart*) 27
people employed (*chart*) 26
Puddling process, 278, 280
Puebla, 760
Pueblo, 288
Puerto Barrios, 749
Puerto Cabello, 724, 726
Puerto Casado, 705
Puerto Montt, 677
Puerto Rico, 219, 220 728, 729, 734, 736, 737, 738, 739
exports to U S, (*chart*) 739
Pulp and paper, 36 39 41 332
Pulp wood:
Canada, 379, 391 392
chemical, 40
factors locating manufacture, 40
importance, 39
mechanical, 40
Newfoundland, 392
Sweden, 495
transportation, 40
Pulp, woods used for, 40
Pulque, 757
Pulse crops, 170
Punjab, 627, 631
Purchasing power in the U. S, 27-28
Pyrenees Mountains, 450, 452
Pyrite, 84, 325, 326, 466

Q

Quarry products, 6
importance of, 47
location of, 48
Quarry products (*Cont.*):
production and value, 49
Quarrying, 334
location of, 48
mechanization, 50
methods, 50
Quartz, 48
Quartzite, 48
Quayaquillite, 688
Quebec.
industries, 390
seaport, 393
Quebracho, 45, 701, 705, 706, 707
Queensland, 649, 651, 654, 656, 657
Quick, Herbert, 25
Quick-freezing process, 315
Quicksilver, 453
Quinia, 681
Quinine, 643
Quotas, 402
on sugar in U S, 220, 221

R

Rabbits
Australia, 656
hair, 299
Radium bearing ore, 381, 479
Railway equipment, manufacture:
British Isles, 406, 407
Germany, 511
Italy, 469
U S S R, 581
United States:
centers, 338-339
types, 338
Raisins, 198, 318, 456, 658
Ramie, 611
Rand, 414
Ranges, western, 257, 258, 265
Raspberries, 199, 200
Rayon, 246, 292, 302-304, 329
Italy, 469
Japan, 594
nature of, 302
processes, 303
raw materials for, 303
United States, centers of manufacture, 303-304
uses, 302-303
Recife district, 712
Recreation, 31
Red Basin, 604, 606, 610
Red River Valley, 148, 164
Red Sea, 424, 471
Red top, 162, 163
Redwood, 18
Reeling silk, 592
Refineries:
aluminum, 82-83
copper, 77
lead, 79, 381
petroleum:
Iraq, 562
Mexico, 755
United States, 118
West Indies, 725
sugar:
beet, 90, 319
cane, 319, 368
zinc, 81

Refining
aluminum, 82-83
copper, 76-78, (*photos*) 76, 78
gold and silver, 84
lead, 79-80
petroleum, 61, 117-119
phosphate rock, 88
pig iron, 278
sugar, 318-319
tin, 83
zinc, 81
Reforestation in:
Germany, 503
Norway, 491
Sweden, 496
Switzerland, 530
United States, 36, 129, 357
results of improved practices, (*chart*) 37
Refrigeration, 330, 643, 655, 664
and animal industries in:
Argentina, 697
Australia, 655
New Zealand, 664
United States, 308
in meat packing, 308, 310, 311, 315
in poultry packing, 273
Registry laws for ships in U. S., 344
Reindeer in Alaska, 364-365, (*photo*) 365
Rejaf, 479
Rennet, 321
Retail sales in U. S., (*map*) 28
Return cargo, 409-410
Rhine River, 512 513
valley, 431, 502, 508, 510
Rhodope Mountains, 540
Rhône-Saône lowland, 430, 431
Rhône Valley, 429, 431, 432, 436, 438, 439
Ricdon, 653
Rice, 681, 712, 723, 737
acreage and production, (*chart*) 636
Asia, southeastern, 636-637
China, 608
Hawaii, 367
India, 625-626
Japan, 589
Rift valley:
Africa, 423
Japan, 586
Riga, 526, 583
Rinderpest, 417
Rio de Janeiro, 711, 717, 719
Rio de Oro, 459
Rio Grande do Sul, 711, 716
Rio Grande Valley, 194
Rio Negro, 697
Riprap, 50
Riviera, 432, 436, 440, 548
Robes, 256
Rock:
constituents, 48
igneous, 47
metamorphic, 48
sedimentary, 47, 397
services of, 48
Rockefeller Medical Foundation, 690
Rocky Mountains, 15, 17
Room-and-pillar method, 50
Root crops, 525, 578
Baltic States, 525
British Isles, 403
Root crops (*Cont.*):
Canada, 388
Denmark, 484
Netherlands, 480
Sweden, 497
Rosario, 703
Rosin, 42, 43
Rostov, 575, 583
Rotary method, 116
Rotterdam, 482
Rouen, 433, 439, 440
Royal Gorge, 15
Rubber growing, 638-640, 710
Rugs, 299, 427
Persian, 564-565
Ruhr district, 503
Rum, 731
Rumania, 545 546
agriculture, 545
exports, 546
manufactures, 545-546
ports, 546
Runoff, 30
Rye:
belt of Europe 506
Germany, 506
natural requirements, 156
U.S.S.R., 577
United States, regions of production, 156-157, (*map*) 153
uses, 156

S

Saar Basin, 438, 503, 510
Saguenay River, 381, 390
Sahara, 444-446
importance to French, 446
St Croix, 738
St Étienne, 433, 434, 439
St Gotthard Pass, 528
St John, Island of, 738
St John (N. B.), 394
St Kitts, 738
St Lawrence River, 159
St. Lawrence Valley, 377, 380, 381, 385, 392
St. Maurice River, 381
St. Thomas, 738
harbor, 740
St Vincent, 738
Sakhalin, 584
Sal trees, 623
Salamanca, Province of, 457
Salmon, 132, 135, 136, 137, 138, 382, 383
Alaska, 364
Salonika, 548, 550
Salt, 13, 19, 74, 95, 325, 326, 329, 330, 332
uses, (*diagram*) 331
Saltpeter, 329
Salt River Valley, 195
Salween River, 622
Samoa, American, 360, 370
Sand, 49
and gravel, 58
uses in U. S., 59
Sandalwood, 624
Sandhill section (N. C.), 191
Sandstone, 56-57
uses in U. S., (*chart*) 57
San Joaquin Valley, 196

Santa Clara Valley, 192
Santa Marta, 727
Santos, 676, 717, 719
São Francisco Valley, 711
São Paulo, State of, 712, 713, 716, 717
São Paulo Railway, 717, (*photo*) 717
São Salvador, 719
São Thomé, 460
São Vincente, 460
Sapotillo tree, 754
Sardines, 135, 433, 434, 443, 454, 492, 590
  at Los Angeles, 136
Sardinia, 465
Satsuma orange, 192
Savanna, 420, 703
Sawdust, 329
Sawmills, 38
  Norway, 491
  Sweden, 495
Scallops, 135
Scandinavian Peninsula:
  climate, 489-491, (*chart*) 490
  economic problems, 498
  geographic features, 488, (*map*) 489
Scarplands, 430, 432
Scotland, 398
Scrap steel, 283, 290
  Italy, 469
  Japan, 595
Sea Island cotton, 241, 738
Seals:
  fur, 132, 139
  leather, 382
Searles Lake, 89
Seaweed, 436, 590
Secondary industries, 6
Semipalatinsk, 574
Semmering Pass, 500
Senegal Valley, 446
Sennar Dam, 427
Service industries, 1
Setubal, 454
Seville, 457, 458
Sewing machine, 304
Shad, 134
Shanghai, 613, 615
Shansi, 606
Shatt al-Arab, 562
Shawenegan Falls, 392
Shawls, 630
Sheep (*See also* sheep *under the various other countries*):
  Argentina, 698-699
  Australia, 655-656
  breeds:
    mutton, 251
    wool, 251
  British Isles, 403, 404
  British South Africa, 417
  fat-tailed, 417, 566
  France, 438
  Iceland, 483
  merino, (*photo*) 266, 655
  New Zealand, 664
  Shropshire, 251, 266
  types, 250-251
    dual-purpose, 250, 262
    mutton, 250, 265, 266, (*photo*) 266
    wool, 250
  United States, 264-267
Sheep (*Cont.*):
  difficulties in raising, 265
  factors controlling distribution, 264-265
  regions of production, 265-267
  Uruguay, 704
Sheffield, 401, 406
Shellac, 624
Shellfish, 132
Shipbuilding, 288, 406, 407, 408, 440, 469, 521
  United States, 343-346
    historical influences, 343-344
    location of shipyards, 343, 346
    ship under construction, (*photo*) 345
Shipka Pass, 547
Ships:
  iron, 3, 243, 344
  for iron ore, 277-278
  oil burning, 740, 765
  sailing, 343, 623, 678, 765
  steam, 343, 765
  steel, 344
  wooden, 343, 494
Shoddy, 299, 405
Shrimp, 132, 135, 136
Siam, 632, 634, 635, 636, 637, 644
Sicily, 464, 465, 466
Sierra Morenos, 454
Sierra Nevadas (Spain), 450, 454
Si Kiang, 603
Silesia, 503, 504, 511
Silica, 63, 71
Silk, 292, 436, 444, 468, 559, 560, 630, 644, 681, 715
  China, 611-612
  Japan, 591-593
  United States, manufacture of, 300-302
    centers, 301-302
    growth of industry, 300
    operations, 301-302
Silver, 74, 83, 86, 380, 652
  Mexico, 754
Silver fox, 383
  ranch, (*photo*) 384
Simplon Pass, 528
Sind, 627, 631
Singapore, 644, 645
Sinkiang, 617
Sisal, 424, 738
Sitka, 363
Skerry guard, 489
Skim milk, 264, 322, 388
Slag, 89, 90, 278
Slate, 38, 48, 49, 57-58
  uses in U. S., (*chart*) 57
Sleeping sickness, 420, 478
Sliver, 294
Slovakia, 528, 535
Small holdings, 476, 481, 485, 506, 525, 535, 545
  Belgium, 476
  China, 607
  Denmark, 485
  France, 435
  Japan, 590
  Philippines, 640
Smelters:
  Alaska, 364
  arsenic, 755
  copper, 77
  Katanga, 415

Smelters (*Cont.*):
lead, 79
zinc, 81
Smelting.
aluminum, 82-83, 533
centers of Canada, 381
copper ore, 76, 77
iron ore, 279, 286
lead ore, 79 80
Norway, 494
south Wales, 400
zinc ore, 81
Smokeless powder, 333, 334
Smyrna, 561, 562
Snowy River, 661
Soaking pit for ingots, 284
Soap, 210, 309
Soapstone, 58
Soda ash, 330 332
Sodium, 84, 95, 330
Soil 209 210 223, 255, 260, 265, 376, 377
advantages, sandy for vegetables, 171, 177
and agriculture 22
clay, 149
coastal plain, 13
drainage, 186
elements 86, 87
fertility, 11, 152, 163
importance, 140
laterite, 621
lava, 148 621
loess, 187 576, 603
porosity, different types, 30
source of, 48
southern States 166
Soil erosion 2, 30, 31, 37, 145, 161, 163 164, 166, 169, 357
Soil for
barley, 155
beans, 181
buckwheat, 157
bush fruits, 199, 200
coffee, 713
corn, 143
cotton, 239, 240
cowpeas, 181
dairying, 259
fruit, 187, 188
hemp, 249
oats, 152
peanuts, 209
potatoes, 178
rye, 156
sorghums, 165
soybeans, 183
sugar beets, 214
sugar cane, 217
sweet clover, 164
sweet potatoes, 180
tobacco, 225-226, 230, 231
tung tree, 208
vegetables, 174, 175, 176, 177
wheat, 147
wool production, 250
Solvent, 333, 334
Somaliland:
French, 447
Italian, 470, 471
Sonora, 755
Sonoran Desert, 752
Sorel cement, 71
Sorghum, 213, 223, 426
Sorgos, 165
South American continent, 666-670
climate, 668-670, (*map*) 669
east-coast countries, 691-720
people, 691
Plata River system, 691, 693
geographic features, 667 668
north coast countries, 721 727, (*map*) 722
people, 721
people, 667
retarded development, 666 667
west coast countries, 670 690
isolation, 670
South Australia, 654, 657
Southeastern Europe
agriculture, 543 544
animals, *chart*) 544
climate 540 541 *chart*) 541
crops, *chart*) 543
foreign commerce 552 *chart*) 551
forests, 542 543
geographic features, 540, (*map*) 539
historical factors 538 540
mineral 543
natural divisions 540
transportation, 539 540, 542
Southern pine, 17 34 338
Southern Rhodesia, 415
South Island 662, 664
Southwest Africa 415
Soybeans, 167
China, 609
flour, 184
importance, 182 183
Manchukuo, 599
markets for, 183
meal, 183
natural requirements, 183-184
oil, 183
United States, 182 184
Spain, 86, 450 459
islands in Atlantic, 458-459
Spanish Africa 459
divisions, 459
industries 459
resources, 459
Spanish Guinea, 459
Spanish Morocco, 459
Sparrows Point, 287
Specialization, 5, 315, 373
automotive manufacture, 340
British manufactures, 404, 405, 406
cattle production, 256
cotton belt, 247
dairying, 261
grapefruit in Texas, 194
iron and steel manufacture, 286, 289
silk manufacture, 301
territorial, 763, 765
wearing apparel manufacture, 305
wool manufacture, 299
Specs, 613
Spiegeleisen, 67
Spinnerets, 302
Spinning, 292 293, (*photos*) 295
Spitzbergen, 491, 492, 572
Sponges, 135, 443, 471, 731

Spruce, 5, 15, 18, 40, 303, 363, 379, 495, 503, 573, 598
Squatters, 655
Staffordshire, 401
Stainless steel, 68, 72
Standardization, 300, 337, 340, 347, 532
Standard of living
and economic nationalism, 768, 772
and use of vegetables, 170-171
Japan, 599
Stand by plants, 353
Stanleyville, 479
Steam engine, 98
Steam plants, 350, 353
costs, 352, 356
efficiency, 352
location in U. S., (*map*) 351
Steam trawler, (*photo*) 137
Steel (*See* Iron and steel)
Stellite, 69
Stevenson restriction plan, 639
Stockholm, 497
Stone
crushed, 49
dimension, 49
expense of preparation, 51
Stone industries, 47-58
Storage, 4
facilities at Montreal, 393
iron ore, 278
lignite, 104
natural gas, 128
wheat, 151
wild plant leaves, 46
Straits of Gibraltar, 459
Strawberries, 199, 200, 201
Subsidies, 342, 343, 344, 402, 403, 444
aviation, 342
shipbuilding, 344
steel industry of Japan, 594
sugar beet industry in England, 403
wheat growing in United Kingdom, 402
Sudan grass, 165
Sudbury district, 68, 379, 380
Sudetes, 503, 504, 510
Suez Canal, 447, 462, 554, 557 558
Sugar in the United States
beet, 319
by-products of refining, 319-320
cane, 318
consumption, 213
imports, 219 221, (*chart*) 220
location of refineries, 319
maple, 223
production, (*chart*) 220
rank, leading states, (*chart*) 218
refining, 318 320
by products of, 90, 319 320, 731
sources of, 213
Sugar Act of 1937, 220
Sugar beets, 162, (*photo*) 215, 599
Australia, 657
British Isles, 403
France, 434
Germany, 507
natural requirements, 213-216
U.S.S.R., 578
United States, 214-217
regions of production, 214-217
Sugar cane, 213, 416
areas of production, 219
Australia, 657-658
Brazil, 712
Cuba, 732-734
Hawaii, 367-368
India, 627
Java, 637-638
natural requirements, 217-218
Peru, 680 681
Philippines, 637 638
syrup, 219
Taiwan 597
United States, 217 219
Sugar-maple tree, 213
Suiva district, 593
Sulphide ores, 75
Sulphite process, 334
Sulphur, 13 19, 74, 75, 77, 93, 325, 326, 329, 491, 687
mining (*diagram*) 94
Sicily, 466
United States, 93-95
Sulphuric acid, 85 90 326 329 330, 334
uses in U. S., (*chart*) 330
Sumatra wrapper tobacco, 231, 232, 638
Sun cure for tobacco, 227
Sunflowers, 577 578
Sunrise mine, 65
Sunshine, effect on fruits, 190
Surinam, 723
Surinam River, 723
Susitna Valley, 366
Sverdlovsk, 581
Swamps, 425, 501, 521, 556, 666
Brazil, 718
Italy, 464
Poland, 518
U.S.S.R., 577
Swansea, 407
Sweatshops, 304
Sweden, 89, 495-498
agriculture 497
cost of floating logs, 495
foreign commerce, 498
forests, 37 495-496
manufactures, 497
minerals, 497
seaports, 498
water power, 496-497
Sweet clover, 164, 222
Swine (*See also* swine *under the various other countries*)
Argentina, 699
Brazil, 715-716
breeds, 263
British Isles, 404
China, 612
desirability of, 262
factors controlling distribution, 262
Germany, 508
U.S.S.R., 579
United States, 262-264
regions of production, 263-264, (*map*) 264
slaughtering, 310
Yugoslavia, 548
Switzerland, 528-533
agriculture, 531

Switzerland (*Cont.*):
dairying, 531
foreign commerce, 533, (*chart*) 533
forests, 530
geographic features, 528-530, (*map*) 529
grazing, 531
manufactures, 531-532
minerals, 530
natural regions, 530
people, 528
tourist industry, 533
water power, 530
Sydney (N.S.W.), 648, 653, 662, (*photo*) 662
Sydney (Nova Scotia), 380
Synthetic-ammonia process, 91
Syria, 558-560
foreign commerce, 559
industries, 559
natural resources, 559
transportation, 559
Syr River, 578
Syrup:
corn, 223
maple, 223
sugar-cane, 219
Szechwan, 604, 612

T

Tacna, 677
Tacoma, 77, 80
Tagua palm, 689
Tagus River, 451
Tahiti lime, 195
Taiga, 573, 574
Taiwan, 596-597, 627
Tampico, 754, 757, 761
Tanganyika, 423, 424
Tangier Zone, 459
Tanning
leather, 45
materials, 44-45, 423
Tashkent, 578
Tasmania, 649, 651, 654, 658
Taxes:
forests, 37
India, 631
southeastern Europe, 543
Tayeh iron ore deposits, 606
Tea:
black, 591, 628
China, 610
East Indies, 642
green, 591, 628
India and Ceylon, 627-628, (*map*) 628
Japan, 591
large-leaf tree, 627-628
Oolong, 597
plantations, 628
small-leaf tree, 627-628
Taiwan, 627
U.S.S.R., 579
Teak, 623-624, 634
Tees River, 407
Tegucigalpa, 748
Tehuantepec lowland, 742, 751, 752, 755
Tela, 749
Telbes iron ore deposits, 575
Tell, 442
Tenant and credit system of southern States, 166
Tennessee River Valley, 88
Ten Thousand Islands, 135
Terra cotta, 62
Terne plate, 83
Textile fibers:
China, 611-612
localization of growing, 236
relative importance, (*chart*) 292
United States, 236-254
uses, 236
Textiles, manufacture of, 332, 333, 526, 716
Belgium, 477
British Isles, 404-406
China, 613
France, 439
Germany, 510, 511, 512
India, 629-630
Italy, 469
Japan, 594-595
Mexico, 759
Netherlands, 482
Norway, future of, 494
Poland, 519
Switzerland, 532
U.S.S.R., 580
United States:
centers, 294-298
distribution, 291-292
distribution of spindles, (*chart*) 298
importance, 305
processes, 292-293
operations, 293-294
Theine, 627
Thermal equator, 707
Thermos car, 262
Thessaly, 549
Thrace, 550
Three Rivers, 392
Throwing silk, 300
Tibet, 616-617
Tides, 397, 434
Tigris Euphrates Valley, 562, 563
Tile, 38, 458
Tile fish, 132
Timbuktu, 446
Timiskaming, 392
Timothy, 161, 163, 164
Tin, 19, 74, 83, 301, 422
Bolivia, 685
China, 607
Malay Peninsula, 635
Tin plate, 83, 407, 624
Tires, 341
Titanium, 70
TNT, 334
Tobacco:
auction warehouse, 234-235, (*photo*) 234
bright yellow, 224, (*photo*) 225, 230, 386, 627
Burley, 230
China, 611
cigar, 231-232
binder, 231
filler, 231
wrapper, 231-232
cigarette, 230
consumption in U. S., (*chart*) 230
curing methods, 227-229, (*photo*) 228
early history, 224
environmental requirements, 224-226

Tobacco (*Cont.*):
fermentation, 228, 229
growing, methods in U. S., 226-227
manufacture in U. S., 232-234
Philippines, 638
regions of production, U. S., 229-232, (*map*) 229
shade grown, 231
Sumatra, 638
Turkish, 546, 549
types in U. S., 229-232, (*map*) 229
varieties, 224
West Indies, 737
Tobago, 730
Tokyo, 594, 595
Ton miles by different transportation agencies in U. S., (*chart*) 24
Toquilla palm, 689
Toronto, 389-390, 394
Tortoise shell, 731
Toulouse Gateway, 429
Tourist trade, 440, 498, 501, 533, 548, 550, 559, 730, 740, 747
Toys, 511
Tractor, farm, 149, 153, 154, 269-270
garden, 172, (*photo*) 173
Trade routes, 763-765
ocean, (*map*) 764
Trade, U. S.:
annual income, (*chart*) 27
employees, (*chart*) 26
Trail, 381
Tram, 300
Trans-Andine highway, 702
Trans-Andine Railway, 697, 702
Trans-Siberian Railway, 568, 615
Transit privileges, 288, 313
Transit trade, 419, 474, 513, 568
Transjordan, 558
Transmission lines of United States, (*map*) 351
Transportation:
and agriculture, 22
annual income of, in U. S., (*chart*) 27
cost for logs, 32
difficulties in:
Alaska, 361, 362, 363, 366
Canada, 376
China, 601
South America, 667
Spain, 450, 452
U.S.S.R., 567-570
equipment, 72, 99, 337-347, 353
Germany, water, 511, 512
importance of, 25-26
and industrial activity, 2
influence of, 26
and manufacturing, 23
people employed by, in U. S., (*chart*) 26
relative cost, corn and livestock, 258, 262
routes of U. S., 13, 14, 15, (*map*) 24
United States, as experiment in, 25
Transvaal, 414
Trapsylvania, 545
Trapping, 364, 383-384, 573, 574, 598
Traprock, 49, 54
Trieste, 469, 470
Trinidad, 725, 730, 731, 735
Tri-state district, 80
Trondheim, 491
Trout, 135, 137
Truck farming, 172-174
Tsetse fly, 417, 420, (*map*) 421, 478
Tsinling Mountains, 603, 605
Tucumán district, 696
Tula basin, 574, 581
Tuna, 132, 135, 136
Tundra, 572-573
Tung-nut oil, 207, 208
Tungsten, 19, 63, 69, 607, 624
Tung tree, 207-209, (*photo*) 208, 609
Tunis, 442, 443
Tunny, 433, 434, 443, 471, 590
Turan lowland, 571, 578, 579
Turin, 467
Turkey, 560-562
European, 550, 551
foreign commerce, 561
industries, 560-561
natural resources, 560-561
plans for economic progress, 561
seaports, 562
Turpentine, 42, 43
wood, 44
Turquoise, 565
Turtles, 135, 731
Túxpan, 754
Tweed Valley, 405
Tyne River, 407
Typhoon, 605

U

Ukraine, 568
Unalaska Island, 363
Unfavorable balance of trade, 411
Union of South Africa, 85, 419
U.S.S.R., 31, 78, 85, 381, 516
agriculture, 575-579
animal industries, 579, (*chart*) 580
climate, 571-572
crops, 577-579, (*chart*) 576
foreign commerce, 581-583, (*chart*) 582
forests, 573-574
geographic features, 570-571, (*map*) 569
manufactures, 579-581
minerals, 574-575
reasons for backwardness, 567-570
seaports, 583
topography, consequences of, 567, 571
trapping, 574
tundra, 572-573
water power, 575
United Fruit Company, 727
experiment stations, 747
railways, 748
shipping, 749
United States:
and economic nationalism, 768-772
energy position, 100, (*chart*) 101
as experiment in transportation, 25
exports, (*chart*) 769
nature of, 769-770, (*chart*) 770
foreign commerce in:
animal products, 273
bauxite, 83
cereals, 150-151, 159
chemicals, 326, 334-336
coal, 106, 107, 108
copper, 77

United States (*Cont.*):
foreign commerce in:
cotton, 247-248, (*chart*) 247
exports, nature of, 769-770, (*chart*) 769
food manufactures, 322-323
fruits, 192, 195, 198, 202
iron and steel, 289-290
kaolin, 60
machinery, 290
markets, (*chart*) 771
minerals, 96-97
nuts, 212
petroleum, 120
phosphate rock, 89
sugar, 219 221, (*chart*) 221
sulphur, 95
textiles, 306-307
tin, 83
tobacco, 235
transportation equipment, 346 347
wheat, 150 151
wool, 252-253
foreign markets, (*chart*) 771
imports, (*chart*) 770
land relief (*map*), 12
natural resources, 11 23
physiographic features 13-15
Appalachian highlands, 13-14
coastal plain, 13
interior plain, 14
western mountains and plateaus, 14-15
power resources, distribution, 101
regional specialization, 11
U S Bureau of Fisheries 130
U S Department of Agriculture, 22 31, 195, 197, 259
U S Department of Commerce, 32
U S Forest Service, 30
U S Geological Survey, 81, 103, 114, 115, 363
Ural Mountains, 568, 569, 570
Uranium, 70
Urga, 616
Uruguay, 703-705
agricultural products, 704
climate, 703-704
foreign commerce, 704-705
manufactures, 704
transportation, 704
Uruguay River, 693

V

Vale of Roses, 547
Valencia oranges, 193, 194, 455
Valenciennes Basin, 433
Valladolid, 455, 457
Valparaiso, 678
Vanadium, 63, 68, 679
Vancouver, 390, 394
Vanilla bean, 757
Vardar Valley, 538, 550
Varna, 547
Varnish, 333
Vegetable oils, 61, 182, 183, 273, 421, 439
Vegetables
dehydrated, 170
growing of in U. S , 172-184
importance, 170
markets for, 176, 177
types of farming in U S , 172-174
uses of in U. S., 170-171
Vehicle factories, 341
Velvet beans, 167
Venezuela, 724-726
cacao, 724
coffee, 724
foreign commerce, 725-726
minerals, 724
Orinoco Basin, 725
seaports, 726
Venice, 469, 470
Veracruz, 761
Victoria, 654, 656, 657, 659
Vicuna, 683, 684
cloth, 684
Vienna, 500 502
Virgin Islands, 738, 740
Viscose process 303
Vistula River, 520
Vitamins
bananas, 743
cereals, 140
fish, 131
fruits, 185
milk, 259
nuts, 203
sweet potatoes, 179
vegetables, 170
Vladivostok 568, 570
Volatile matter in coal, 103, 104
Volga River, 568 570
Vosges Mountains, 434
Vuelta Abajo district 737

W

Wagonmakers 341
Wake Island 360 369
Wales 396 398, 399, 400, 407
Walfish Bay, 420
Walnuts, 203
black, 206
English, 205
Persian 205
white, 206
Wankie, 415
Warszawa [Warsaw], 519, 520
Watches, 532
Water power, 2 13, 14, 30, 36, 40, 98, 100, 101, 296, 297, 301, 312, 376
Brazil, 711
Canada, 377, 381 382
France, 434
Germany, 504 505
Norway, 491 492
Sweden, 496 497
Switzerland, 530
Tasmania, 654
U S S R , 575
United States, 123-124
developed at selected sites, (*chart*) 357
efficient utilization, 128-129
potential at selected sites, (*chart*) 357
regional distribution, (*chart*) 124
Wattle, 423, 651
Wearing apparel, manufacture of, 304-305
Weaving, 293, 294, 298, (*photo*) 296
Weighting silk, 302
Wellington Plain, 664
Western Ghats Mountains, 621, 622
Western Sierra Madre Range, 752

Western Territory, Australia, 654, 655, 657
West Indies, 728 740
Westphalian district, 503
West River Valley, 604-605, 608
Whaling industry, 132, 493-494
Wheat.
  baking quality, 148
  China, 608 609
  classes, 147 148
  France, 435
  India, 626
  markets for, 149
  milling quality, 148
  natural requirements, 146-147
  qualities 146
  U S S R , 577
  United States, regions of production, 148 150
  white, 148
Whisky, 112, 156
White Leghorn poultry, 271
White Nile River, 425, 426, 427, 555, 556
Wichita, Kansas, 343
Wild grasses in United States, 162, 164
Wild plant industries in United States, 45
Willamette Valley, 192, 267
Wilmington, Del , 334
Windmills, 480, 697
Windward Islands, 729
Wine, 198, 200, 444, 456, 458, 508, 544, 658, 696, 697, 700
  France, 437
  Portugal, 456
  Spain 456
Winnipeg, 381
Winter vegetable industry:
  Atlas countries, 444
  Bermudas, 403
  Channel Islands, 403
  France, 436
  Mexico, 757
  United States, 174 176
  West Indies, 735
Wolframite, 454, 607
Wood in the United States:
  cut, per capita, *32*
  disposition of, (*chart*) 35
  for paper, *39*
  preservatives, 35
  second growth, 36
  uses of, *32*
Wood oil, 207, 208, 609
Wool, 298 300
  Argentina, 698, 699
Wool (*Cont.*):
  Australia, 655-656
  breeds of sheep, 251
  British South Africa, 417
  centers of manufacture in U S., 299-300
  classes, 251-252
    fine, 251-252
    long, 252
    medium, 252
  importance of, 250
  manufacturing operations, 298-299
  nature of, 250
  New Zealand, 664
  United States
    manufacture of, 298-300
    regions of production, (*map*) 253
Woolens, 298, 299
Worsted, 298, 299, 300
Wrought iron, 278, 280

Y

Yaguron, 706
Yak, 617
Yakutsk, 572, 574, 575
Yangtze River Valley, 603-604, 610, 611, 612
Yellow fever, 666, 690
Yellow pine, 16, 18, 40
Yellow River Valley, 603, 606, 608
Yellow Sea, 605
Yemen, 563
Yerba maté, 706-707 713
Yokohama, 594, 595
Yucatan, 729, 754, 757
Yugoslavia, 547-548
  agriculture, 547-548
  exports, 548
  manufactures, 548
  seaports, 548
Yukon River, 135, 361
  Valley 362, 363, 365

Z

Zagros Mountains, 565
Zambesi River, 419
Zanzibar, 424, 425
Zinc, 18, 74, 79, 80-81, 84, 380, 381, 454, 652, 754
Zinc chloride, 36
Zirconium, 68, 70
Zuider Zee, 479, 480
Zululand, 416
Zurich, 532, 533